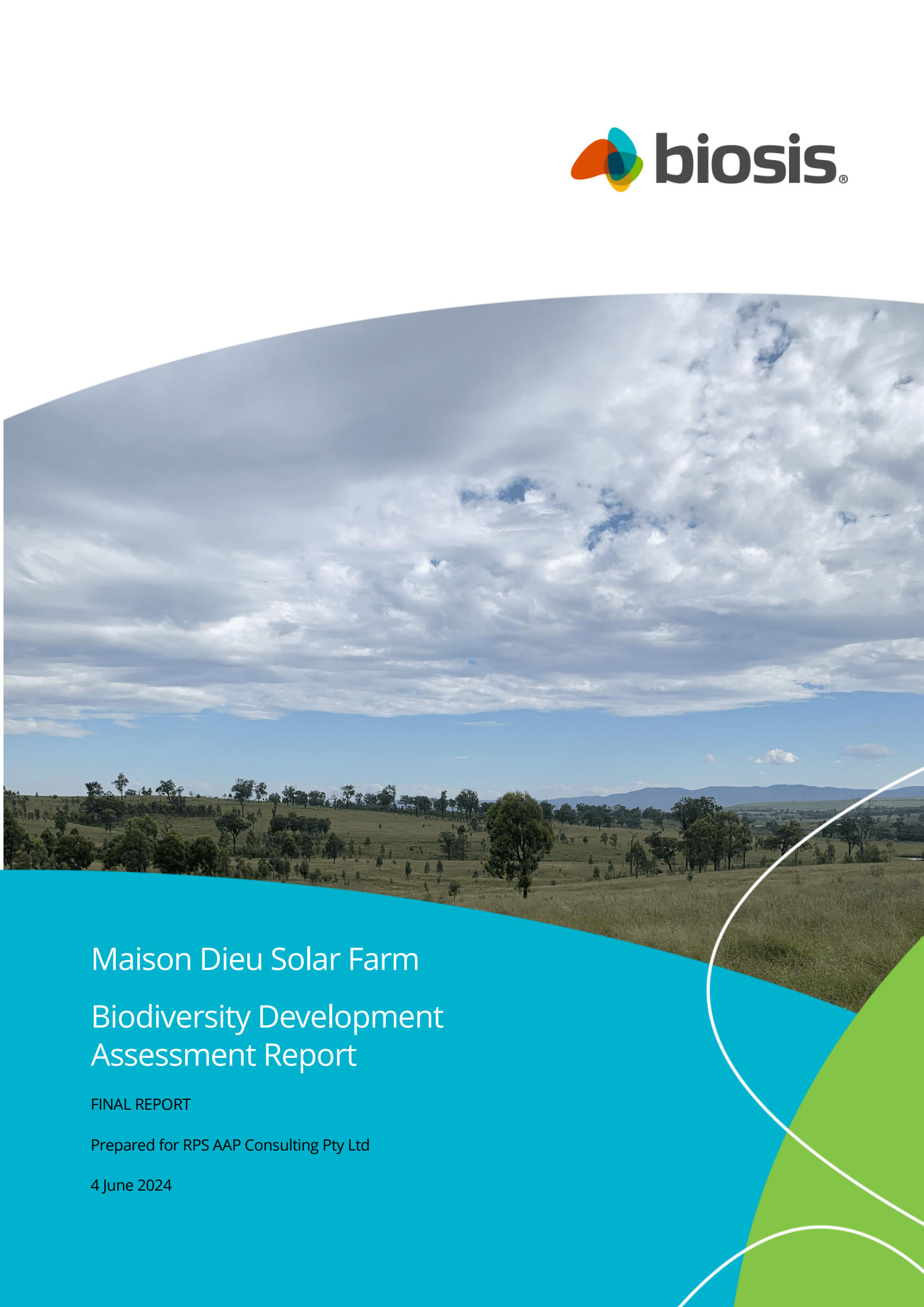




Maison Dieu Solar Farm Biodiversity Development Assessment Report

FINAL REPORT

Prepared for RPS AAP Consulting Pty Ltd

4 June 2024

Biosis offices

NEW SOUTH WALES

Albury

Phone: (02) 6069 9200

Email: albury@biosis.com.au

Gosford

Phone: (02) 9101 8700

Email: gosford@biosis.com.au

Newcastle

Phone: (02) 4911 4040

Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700

Email: sydney@biosis.com.au

Western Sydney

Phone: (02) 9101 8700

Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090

Email: wollongong@biosis.com.au

VICTORIA

Ballarat

Phone: (03) 5304 4250

Email: ballarat@biosis.com.au

Melbourne

Phone: (03) 8686 4800

Email: melbourne@biosis.com.au

Wangaratta

Phone: (03) 5718 6900

Email: wangaratta@biosis.com.au

Document information

Report to: RPS AAP Consulting Pty Ltd

Prepared by: Brendon True (BAAS18155)

Accredited Assessor: Brendon True (BAAS18155)

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Glossary

Assessment Area	All land within 1500 m of a site based development
BAM	NSW Biodiversity Assessment Method
BAM-C	BAM Calculator
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCS	Biodiversity Conservation and Science, Department of Climate Change, Energy the Environment and Water (NSW DCCEEW)
BDAR	Biodiversity Development Assessment Report
BESS	Battery Energy Storage System
Biosecurity Act	<i>Biosecurity Act 2015</i>
BOS	Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
Cth DCCEEW	Australian Government Department of Climate Change, Energy, the Environment and Water
Development site	The area of land that is directly impacted by the Project, synonymous with the disturbance footprint
Disturbance footprint	The area of land that is directly impacted by the Project, synonymous with the development site
DoIW	Directory of Important Wetlands
DP	Deposited Plan
DPE	NSW Department Planning and Environment
DPHI	NSW Department of Planning, Housing and Infrastructure
DPI	NSW Department of Primary Industries
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development
Ecosystem credit species	Threatened species whose occurrence can generally be predicted by vegetation surrogates and/or landscape features, or that have a low probability of detection using targeted surveys. A targeted survey is not required to identify or confirm the presence of ecosystem credit species.
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	Fisheries Management Act 1994
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System

IBRA	Interim Biogeographic Regionalisation of Australia
kV	Kilovolt
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
Locality	Area located within 10 km radius from the subject land
LPI	NSW Land and Property Information
MNES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
MW	Megawatt
NSW	New South Wales
NSW DCCEW	NSW Department of Climate Change, Energy, the Environment and Water
OEMP	Operational Environmental Management Plan
PCT	Plant Community Type
Project area	The area that the development application applies to.
PV	Photovoltaic
SAII	Serious and Irreversible Impact
SALIS	NSW Soil and Land Information System
SEPP	NSW State Environmental Planning Policy
Species credits	A class of biodiversity credits required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates
Species credit species	Threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. A targeted survey or an expert report is required to confirm the presence of these species on the subject land. Alternatively, the applicant may elect to assume the species is present for development/clearing projects only.
SSD	State Significant Development
Study area	The area investigated to identify biodiversity constraints for the Project.
Subject land	The areas within or the combined areas of the development site, and any indirect and prescribed impacts.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
TPZ	Tree Protection Zone
WIA	Water Impact Assessment
WM Act	NSW <i>Water Management Act 2000</i>
WHS	Work Health and Safety
VI	Vegetation Integrity

Certification and Declarations

I certify that this report has been prepared based on the requirements of, and information provided under the Biodiversity Assessment Method (DPIE 2020) and s6.15 of the *Biodiversity Conservation Act 2016*.

In preparing this assessment I have acted in accordance with the Accredited BAM Assessor Code of Conduct.

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.

Signature:	Brendon True
Date:	31 May 2024
BAM Assessor Accreditation Number:	BAAS18155

Summary

Biosis Pty Ltd (Biosis) was engaged by RPS AAP Consulting Pty Ltd (RPS) to undertake a biodiversity assessment of the Maison Dieu Solar Farm at Maison Dieu, near Singleton in New South Wales (NSW) (the Project) for Terrain Solar Pty Ltd. The Project would construct, operate and maintain a solar farm and BESS with a capacity of up to 60 megawatts (MW) and 40 MW (and 2 hour storage) respectively. The Project would also install a transmission connection to the existing Maison Dieu Substation (Figure 1).

The Project is considered State Significant Development (SSD) and would be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979 (NSW)* (EP&A Act). The Project triggers the Biodiversity Offsets Scheme (BOS), and assessment is required in accordance with the *NSW Biodiversity Assessment Method (BAM)* (DPIE 2020a) and the *Biodiversity Conservation Act 2016 (NSW)* (BC Act). This Biodiversity Development Assessment Report (BDAR) has been prepared by Accredited Assessor Brendon True (BAAS18155) and reviewed by Accredited Assessor Mitch Palmer (BAAS17051). This BDAR describes the outcome of the development assessment case (00037099/BAAS18155/22/00037100) conducted consistently with the BAM.

Field investigation of the subject land, the area incorporating the disturbance footprint and additional lands assessed for indirect and prescribed impact, in accordance with the BAM, recorded 194.26 hectares of native vegetation, comprised of the following plant community types (PCTs) and threatened ecological communities listed under the BC Act and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- 175.92 hectares of PCT 3431 - Central Hunter Ironbark Grassy Woodland.
- 58.72 hectares represents *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions* (Central Hunter Grey Box Ironbark Woodland)) (Endangered, BC Act).
- 43.17 hectares represents *Central Hunter Valley Eucalypt Forest and Woodland*) (Critically Endangered, EPBC Act).
- 18.35 hectares of PCT 4015 - Central Hunter Swamp Oak Riparian Forest.
- 12.67 hectares represents Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Endangered, EPBC Act).

Targeted survey for candidate species from December 2022 through January 2024 revealed four species credit species as present or utilising habitats within the subject land:

- Hunter Valley Delma *Delma vescolineata*, assessed throughout as Striped Legless Lizard *Delma impar* (Vulnerable, BC Act and EPBC Act) following consultation with NSW and Commonwealth regulators—detected via artificial habitat installation and monitoring.
- Brush-tailed Phascogale *Phascogale tapoatafa* (Vulnerable, BC Act)—detected via remote camera.
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act) – identified via ultrasonic call detection.
- Powerful Owl *Ninox strenua* (Vulnerable, BC Act) – identified via call detection.

Consideration has been given to avoiding and minimising impacts to biodiversity, where possible, especially during the assessment and preliminary design, resulting in the significant reduction of the original Project area to avoid known biodiversity values. Mitigation and management measures will be put in place to adequately address direct, indirect and prescribed impacts associated with the Project.

For impacts that are unavoidable, the following biodiversity credits are required for the Project, in accordance with Section 10 of the BAM:

- PCT 3431 – 817 credits for 75.74 ha of impact.
- PCT 4015 – 3 credits for 0.10 ha of impact
- Striped Legless Lizard – 660 credits for 75.74ha of impact.
- Brush-tailed Phascogale – 167 credits for 10.89 ha of impact.
- Southern Myotis – 608 credits for 50.83 ha of impact.
- Powerful Owl - 55 credits for 4.02 ha of impact.

Other threatened species recorded, ecosystem credit species, that would be impacted but do not require species credit offsetting under the BOS include:

- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* (Vulnerable, BC Act).
- Eastern False Pipistrelle *Falsistrellus tasmaniensis* (Vulnerable, BC Act).
- Greater Broad-nosed Bat *Scoteanax rueppellii* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris* (Vulnerable, BC Act).
- Large Bent-winged Bat *Miniopterus orianae oceanensis* (Vulnerable, BC Act).
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, BC Act and EPBC Act).
- Little Bent-winged Bat *Miniopterus australis* (Vulnerable, BC Act).
- Grey-crowned Babbler *Pomatostomus temporalis temporalis* (Vulnerable, BC Act)
- Speckled Warbler *Chthonicola sagittata* (Vulnerable, BC Act).
- Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable, BC Act and EPBC Act)

The Project is considered to have the potential to result in a significant impact to species or communities listed under the EPBC Act. As such, referral (EPBC 2023/09638) was made to the Federal Minister for the Environment and Water. The Project was subsequently determined a controlled action on 31 January 2024 under the EPBC Act controlling provisions of listed threatened species and communities (sections 18 and 18A). This BDAR serves as the required assessment under the bilateral agreement with NSW.

STAGE 1 – BIODIVERSITY ASSESSMENT

1 Introduction

Biosis Pty Ltd (Biosis) was engaged by RPS AAP Consulting Pty Ltd (RPS), on behalf of Terrain Solar, to undertake a biodiversity assessment of the Maison Dieu Solar Farm at Maison Dieu, near Singleton in New South Wales (NSW) (the Project) for Terrain Solar Pty Ltd (the Applicant).

The purpose of this assessment was to apply the NSW Biodiversity Assessment Method (BAM) (DPIE 2020a) to the Project, and provide RPS with a Biodiversity Development Assessment Report (BDAR). The BDAR supports a State Significant Development (SSD) Development Consent approval under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (SSD-48160216), as an appendix to the Environmental Impact Statement (EIS) for the Project.

The impacts and proposed mitigation for the proposed construction, operation and decommissioning phases of the Project are addressed in this report, in accordance with relevant regulatory, requirements and guidelines.

1.1 Project description

The Project will involve the construction, operation and decommissioning of a photovoltaic (PV) solar farm, Battery Energy Storage System (BESS) and associated infrastructure. The Project generally includes:

- Construction:
 - Up to 18 months with a maximum number of workers up to 150 Full-Time Equivalent (FTE) personnel;
 - Hours of operation generally between 7 am to 6 pm, Monday to Friday and 8 am to 1 pm, Saturday;
 - Pre-construction activities and site establishment;
 - Civil works and access upgrades;
 - Major components transported via Port of Newcastle or Port Botany;
 - PV array construction utilising external equipment;
 - Installation and use of temporary infrastructure (including office, parking, amenities, laydown, waste storage, stockpile, power supply, fencing, communications, services and utilities);
 - Ancillary activities (including import of gravel, sand and aggregate; and water);
 - Rehabilitation;
- Operation:
 - Approximately 110,000 PV solar arrays with a total capacity of 60 Mega Watts (MW);
 - BESS with a capacity of approximately 40 MW / 80 MW hours (2 hours storage);
 - Electrical infrastructure including:
 - Solar PV power conversion units with inverters;
 - Substation compound and switching station;

- Electrical reticulation grid and infrastructure connecting to existing Ausgrid Singleton Substation;
- Site access and external transport;
- Other associated infrastructure (including retained temporary construction infrastructure and its maintenance);
- Internal and external ancillary activities;
- 24 hours a day, 7 days a week with up to five FTE personnel;
- Decommissioning:
 - Individual components are expected to operate for up to 30 years, after which:
 - Replace the existing Project components within the Project description and impacts assessed in this EIS and continue operations in consultation with relevant associated holders; or
 - Seek relevant approvals should technological advances not confirm the viability of the above; or Decommission the Project and rehabilitate the site.

The Project has been assessed as triggering the NSW Biodiversity Offset Scheme (BOS) as the Project is considered an SSD. The NSW *Biodiversity Conservation Act 2016* (BC Act) requires that the BAM be applied to all projects that trigger the BOS, and that a BDAR is required to be submitted to the approval authority.

1.2 Purpose of this assessment

This BDAR will:

- Address the BAM (DPIE 2020a) and the BOS.
- Identify how the applicant has avoided and minimised impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed development.
- Consider and assess the Project in accordance with other relevant legislation such as the Commonwealth *Environmental Protection and Conservation Act 1999* (EPBC Act).

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and reviewed by Accredited Assessor Brendon True (BAAS18155). This BDAR describes the outcome of the development assessment case (00037099/BAAS18155/22/00037100) conducted consistent with the BAM.

1.1 The subject land, disturbance footprint and assessment area

The following terms are used throughout this BDAR and are defined below.

- The subject land is defined as the area incorporating the disturbance footprint and additional lands assessed for indirect and prescribed impacts, as siting and design of the Project progressed. The BAM has been applied to this area. The subject land is in the Singleton Shire Council Local Government Area (LGA) and the Hunter Local Land Services (LLS) Region. The subject land includes all or part of the following Deposited Plans (DPs) and Lots:

- Lot 3 DP252505.
 - Lot 51 DP1133756.
 - Lot 1 DP1133341.
 - Lot 104 DP817010.
- The study area is a broader area than the subject land, which was the initial focus of early field investigations to explore constraints and opportunities for the Project, and key for implementing avoidance and minimising principles.
- The assessment area includes the subject land and the area of land within the 1500 m buffer zone surrounding the subject land.
- The Project Area is the area the development application applies to, which sits within the subject land.
- The disturbance footprint comprises the area of land that is directly impacted by the Project, including those key components of the Project listed in Section 1.1.

1.3 Sources of information

Sources of information used in the assessment included relevant databases, spatial data, literature and previous site reports.

In order to provide a context for the assessment area, records of flora and fauna from within 10 kilometres (the locality) were collated from the following databases and datasets were reviewed:

- Commonwealth Department of Climate Change, Energy, the Environment and Water (Cth DCCEEW) Protected Matters Search Tool for matters protected by the EPBC Act.
- NSW BioNet - the database for the Atlas of NSW Wildlife, Department of Planning and Environment (DPE), for species, populations and ecological communities listed under the BC Act.
- NSW BAM Calculator (BAM-C).
- Native vegetation regulatory map.
- BAM Important Habitat maps (DPE 2023a)
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.
- Department of Primary Industries (DPI) (Fisheries) Spatial Data Portal.

Other sources of biodiversity information relevant to the assessment area were sourced from:

- The NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database (NSW DCCEEW 2024).
- Relevant vegetation mapping, such as the State Vegetation Type Map (DPE 2023b).

The following reports were also reviewed and relied on to provide additional information:

- Maison Dieu Solar Farm – Scoping Report (EMM Consulting 2022).

Basemap data was obtained from NSW Land and property information (LPI) 1:25,000 digital topographic databases, with cadastral data obtained from LPI digital cadastral database.

The following spatial datasets were utilised during the development of this report:

- Catchment Boundaries of New South Wales dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DoIW).
- State Environmental Planning Policy (Resilience and Hazards) 2018.
- Spatial data associated with the State Vegetation Type Map (DPE 2023b).
- NSW Soil and Land Information System (SALIS).
- Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been provided:
 - Digital mapping with aerial photography showing 1:1000 or finer.
 - Site map as described in subsection 3.1.1 of the BAM (DPIE 2020a).
 - Location map as described in subsection 3.1.2 of the BAM (DPIE 2020a).
 - Landscape map with features including 1,500 metre buffer, as described in section 3.1.3 of the BAM (DPIE 2020a).

1.4 Legislative requirements

The Project has been assessed against relevant biodiversity legislation and government policy, including:

- EPBC Act.
- EP&A Act.
- BC Act.
- *Fisheries Management Act 1994* (FM Act).
- *Biosecurity Act 2015* (Biosecurity Act).
- State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP).
- State Environmental Planning Policy (Resilience and Hazards) 2018 (Resilience and Hazards SEPP).

The former NSW Department of Planning and Environment (DPE), which is now the NSW Department of Planning, Housing and Infrastructure (DPHI), issued the Secretary's Environmental Assessment Requirements (SEARs). Each SEAR relevant to this BDAR and where in this BDAR each is addressed are detailed in Table 1. Details of the supplementary SEARs issued on 12 February 2024 are detailed in Table 2.

Table 1 SEARs (SSD-48160216) relating to biodiversity and where Addressed

SEAR	Where addressed in this report
An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the <i>Biodiversity Conservation Act 2016</i> (NSW) (BC Act), the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR), including a detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts (including on grasslands) of the development over time, and a strategy to	Sections 2 through Section 8.

SEAR	Where addressed in this report
offset any residual impacts of the development in accordance with the BC Act.	
An assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the <i>Fisheries Management Act 1994</i> , and a description of the measures to minimise and rehabilitate impacts, including impacts to the Hunter River and unnamed watercourses flowing across the site.	Section 2 and Section 9.5.
If an offset is required, details of the measures proposed to address the offset obligations.	Section 6 and Section 10

Table 2 Supplementary SEARs (SSD-48160216) relating to biodiversity and where Addressed

SEAR	Where addressed in this report
The EIS must identify each EPBC Act listed threatened species and community likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	Sections 6.1 and Section 9.1, Appendices 4 and 6
For each of the EPBC Act listed threatened species and communities likely to be impacted by the action the EIS must provide a separate: i. description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans; ii. details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; iii. description of the relevant impacts of the action having regard to the full national extent of the species or community's range; iv. description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action; v. identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; vi. a description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established; vii. details of how the current published NSW Biodiversity Assessment Method (BAM) has been applied in accordance	Habitat assessment – Appendix 4 Survey methodologies – Section 4 Impact assessment – Sections 6.1 and Section 9.1, Appendices 4 and 6. Mitigation measures – Section 7. Offset package – Section 11.

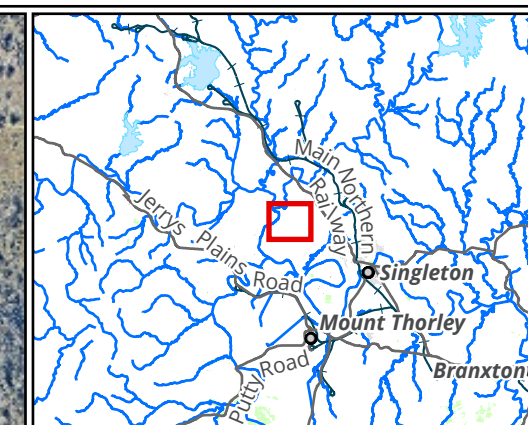
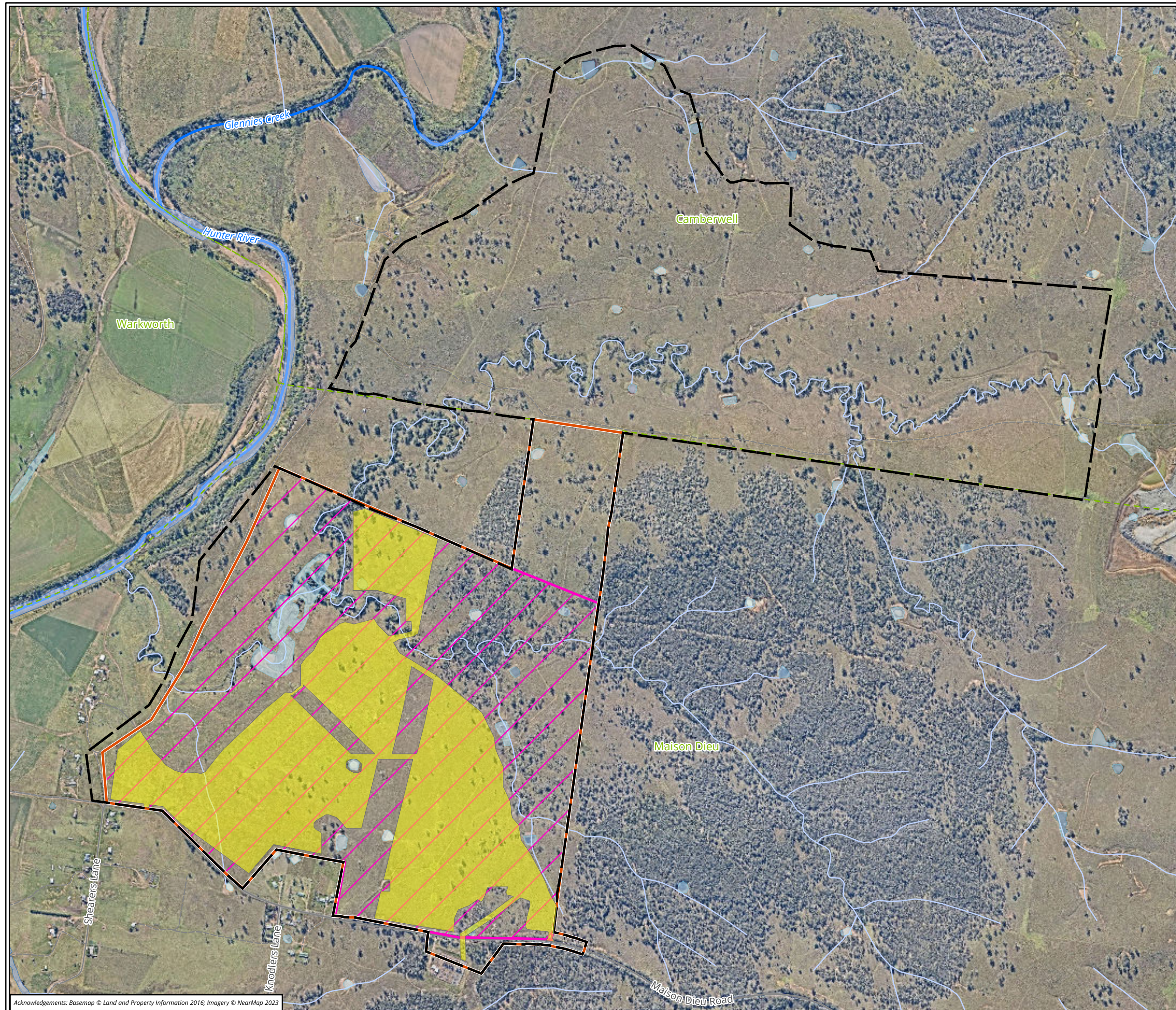
SEAR	Where addressed in this report
with the objects of the EPBC Act to offset significant residual adverse impacts; and viii. details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the BAM and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	
If an offset is required, details of the measures proposed to address the offset obligations.	Section 10
Appendix A: Assessment required for specific EPBC act listed threatened species and communities	Habitat assessment – Appendix 4 Survey methodologies – Section 4 Impact assessment – Sections 6.1 and Section 9.1, Appendices 4 and 6.

1.5 Consultation

Consultation was carried out with the NSW Biodiversity Conservation and Science (BCS) and assessing officers from the NSW DCCEEW and Cth DCCEEW on multiple occasions during the assessment phase of the Project. A summary of the consultation undertaken is demonstrated below in Table 3.

Table 3 Consultation summary

Date	Consultation	Purpose
18/04/2023	BCS and map review team	Request NVR map for to assist with land category assessment
03/08/2023	Biosis, RPS, Terrain Solar and Cth DCCEEW	Pre-referral meeting and project overview
17/08/2023	Biosis, RPS, Terrain Solar and BCS assessment team (Hunter)	Online meeting with project overview
05/09/2023	Biosis and BCS assessment team – Hunter	Request endorsement of small variation to Delma survey method
10/11/2023	Biosis and BCS assessment team – Steve Lewer, Giorginna Xu and Jayme Lennon	Site visit, discussion on survey and BAM assessment
11/04/2024	Biosis, Terrain Solar and BCS assessment team – Steve Crick and Giorginna Xu	Pre lodgement meeting. Discussion on approach and general consensus for offsetting requirements for Delma



Legend

- Subject land
- Study area
- Disturbance footprint
- Project area

Figure 1 Subject land

0 100 200 300 400

Meters

Scale: 1:13,000 @ A3

Coordinate System:

GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024,
GIS: JB, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\
38104_MaisonDieu_BDAR.aprx
Layout: 38104_F1_SubjectLand

2 Landscape Context

This chapter describes the landscape and site context of the subject land, describing the landscape features present within the subject land and within a 1500 metre buffer, as required by the BAM (DPIE 2020a). Figure 2 shows the subject land and landscape features at the site scale. Figure 3 shows the location of the subject land and landscape features within the 1500 metre buffer.

2.1 Subject land description

The subject land is located around 10 kilometres northwest of Singleton in the suburb of Maison Dieu, NSW. Current land use is farming (cattle grazing) with much of the subject land cleared of woody vegetation for this purpose. The subject land occurs within proximity (around 120 metres) to the Hunter River at its nearest point.

The subject land does not include any buildings, however, residences and farming infrastructure occur in the surrounding landscape. As mentioned, much of the subject land has been cleared woody vegetation with that remaining predominantly associated with waterways and drainage lines that are tributaries of the Hunter River.

The subject land is within the Singleton 1:250k map sheet with the underlying soil landscape mapped as Roxburgh (Kovac & Lawrie 1991). The Roxburgh soil landscape is described as covering undulating low hills and undulating hills, containing yellow podzolic soils and occurring on upper to midslopes with red solodic soils on more rounded hills.

2.1.1 Native vegetation cover

Vegetation within the assessment area (within the 1500 metre buffer area) was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping. The total area of the 1500 metre buffer around the subject land is 1,954.7 hectares, with the area of native vegetation mapped within the buffer being 849.6 hectares (Figure 3). This is a native vegetation cover of 43.5 % (>30–70 % class as defined in Section 3.2.3 of the BAM (DPIE 2020a) and this value was entered into the BAM calculator.

2.1.2 IBRA Bioregions and subregions

The assessment area occurs within the Sydney Basin IBRA bioregion and the Hunter IBRA subregion.

The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53 % of NSW and is one of two bioregions contained wholly within the state. The bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The bioregion is bordered to the north by the North Coast and Brigalow Belt South bioregions, to the south by the South East Corner Bioregion and to the west by the South Eastern Highlands and South Western Slopes bioregions. The Sydney Basin Bioregion is one of the most species diverse in Australia. This is a result of the variety of rock types, topography and climates in the bioregion (DPE 2016).

2.1.3 Rivers and streams

The subject land is located within the Hunter Local Land Services Region and the Hunter River catchment. The closest river is the Hunter River which is located approximately 120 metres west of the subject land at its nearest point.

The subject land contains several unnamed waterways that coalesce into one 4th order stream (Strahler 1964) in the west of the subject land that is a tributary of the Hunter River (Figure 2).

There are Key Fish Habitats (KFH) as mapped by the NSW Department of Primary Industries (DPI) within the subject land as well as the Hunter River (DPI 2023). The Hunter River and Glennies Creek to the north are also mapped as habitat for the FM Act listed Southern Purple Spotted Gudgeon *Mogurnda adspersa* (DPI 2023) (Figure 2).

2.1.4 Wetlands

No parts of the subject land are mapped as containing a wetland, however, small sections of the Hunter River downstream of the subject land are mapped as containing floodplain wetlands (DPE 2023c) (Figure 3). The nearest wetland included in the DoIW of Australia (Cth DCCEEW 2005) is Kooragang Nature Reserve over 64 kilometres to the south-east of the subject land.

2.1.5 Connectivity

Connectivity of wooded vegetation through the subject land is poor save for a vegetated riparian corridor and sparse bushland in the north and north-east of the subject land respectively. These areas, however, are connected to a significant patch of bushland covering over 700 hectares to the east and south-east. Furthermore, more diffuse connectivity is present via a vegetated riparian corridor to bushland to the north-east. No highly vegetated areas occur to the west and south owing the highly cleared nature of the Hunter River floodplain at this location (Figure 3).

The connectivity described above enables the movement of both highly mobile species such as birds, and those more restricted in mobility such as arboreal fauna, through the landscape. Connectivity between the subject land and the surrounding landscape, particularly on the eastern and southern margins, means that wooded vegetation within the subject land is accessible to most fauna that inhabit the large patch of bushland to the east.

The waterways within the subject land provide connectivity of aquatic habitats, however, due to a high degree of ephemerality, this habitat is unlikely to be suitable for strictly aquatic species and typically only inhabited by commonly occurring amphibians.

2.1.6 Geological features of significance

There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the subject land or expected to occur within the assessment area.

2.1.7 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value mapped within the subject land.

2.1.8 NSW (Mitchell) Landscape

The subject land occurs across three within Mitchell Landscapes (Department of Environment & Climate Change NSW 2002) (Figure 2):

- Central Hunter Foothills
- Upper Hunter Channels and Floodplain
- Central Hunter Alluvial Plains

The Central Hunter Foothills Mitchell Landscape covers the vast majority of the subject land. This landscape occurs on undulating lowlands, rounded to steep hills with rock outcrop on ridges on Permian lithic sandstone, conglomerate, shale and coal, general elevation 40 to 300 metres with a few higher peaks, local relief 30 to 120 metres. Red-brown to yellow brown harsh texture-contrast soils on slopes, dark coloured clays in valleys and limited accumulations of sand and gravel in streams. Woodlands to open forest of Spotted Gum *Corymbia maculata* Forest Red Gum *Eucalyptus tereticornis*, Narrow-leaved Ironbark *E. crebra*, Red Ironbark *E. sideroxylon*, White Box *E. albens*, Slaty Gum *E. dawsonii*, Rough-barked Apple *Angophora floribunda* with Kangaroo Grass *Themeda triandra* and wallaby grass *Rytidosperma* spp.

The Upper Hunter Channels and Floodplain covers a small portion of the subject land correlating with the path of the Hunter River. This landscape includes channels, floodplains and terraces of the Hunter River and its tributaries upstream of Denman on Quaternary alluvium, general elevation 100 to 200 metres, local relief 25 metres. Vegetation is characterised by open grassland with White Box, Yellow Box *Eucalyptus melliodora*, Blakely's Red Gum *E. blakelyi*, Rough-barked Apple and patches of Swamp Oak *Casuarina glauca* on brackish and saline flats, River Oak *C. cunninghamiana* along the streams.

The Central Hunter Alluvial Plains landscape is positioned similarly to the Upper Hunter Channels and Floodplain, also occurring on the channel, floodplain and terraces of the Hunter River on Quaternary alluvium, general elevation 20 to 40 metre, local relief 15 metre. Vegetation is open grasslands with scattered Yellow Box, Forest Red Gum, Rough-barked Apple, patches of Swamp Oak on brackish and saline flats, River Oak along the streams.

As the Central Hunter Foothills landscape is the dominant landscape within the subject land, this landscape was entered into the BAM-C for this assessment.

2.1.9 Additional landscape features

No additional landscape features of note are present within the subject land.

2.2 Land categorisation assessment

A review of land categorisation under the LLS Amendment Act was undertaken to clarify the native vegetation management regime. Where applicable to do so (land applicable to the LLS Act i.e. rural), the potential for land to be mapped as Category 1 – exempt land (Category 1 land) was evaluated, as land mapped or determined as Category 1 land can be excluded from the BAM and is not required to be assessed, with the exception of prescribed impacts in reference to relevant legislation provided below:

- BC Act s6.8(3): The biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1 – exempt land (within the meaning of Part 5A of the LLS Act 2013), other than any impacts prescribed by the regulations under section 6.3.

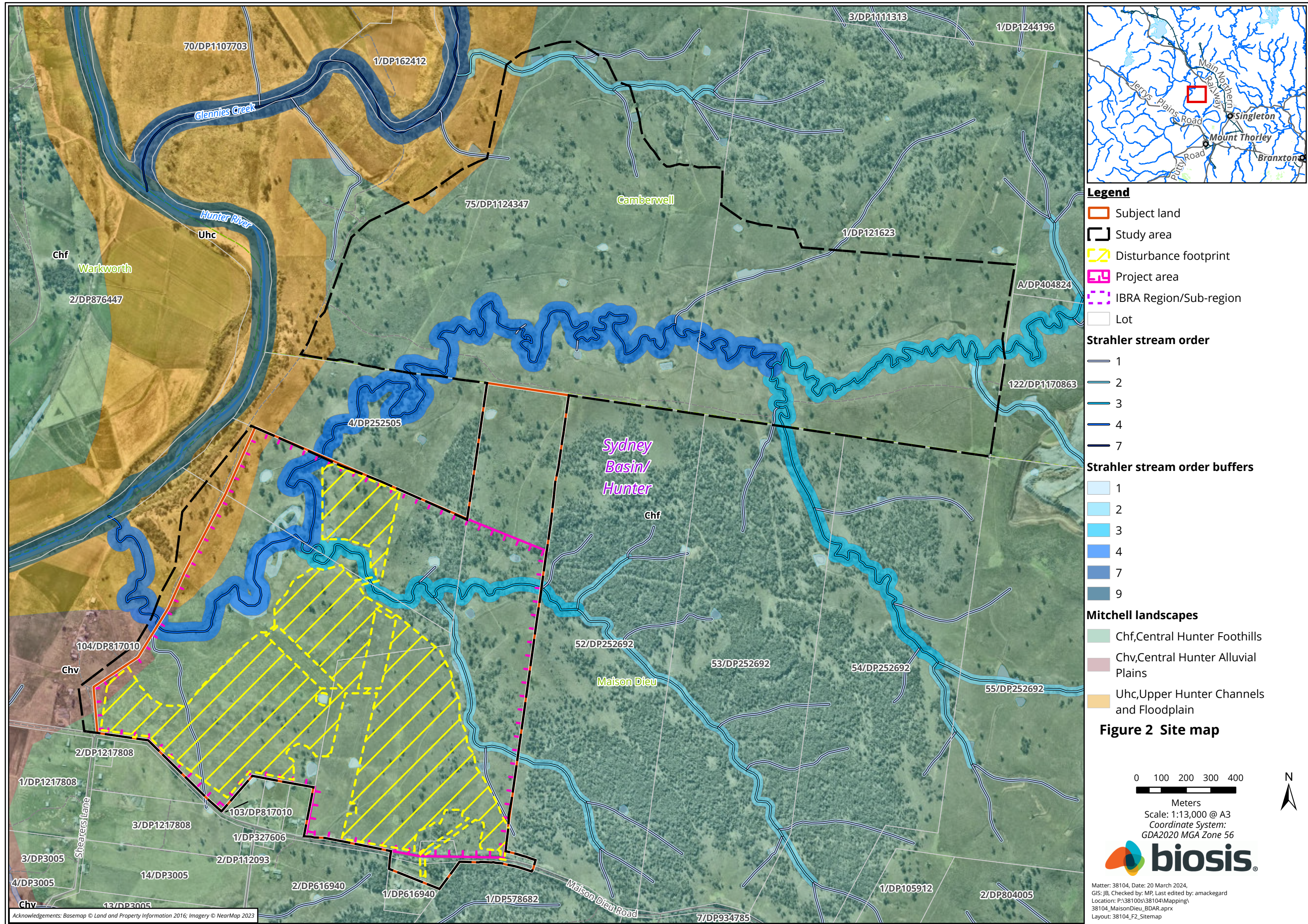
- BAM cl1.5: Biodiversity values not assessed under the BAM include: (d) biodiversity values associated with the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the LLS Act), other than the additional biodiversity impacts in accordance with clause 6.1 of the BC regulation; (that being prescribed impacts).

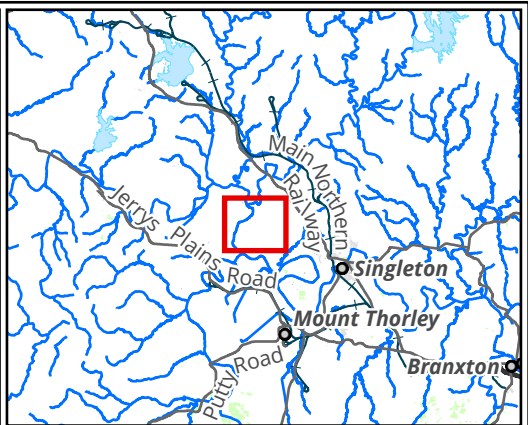
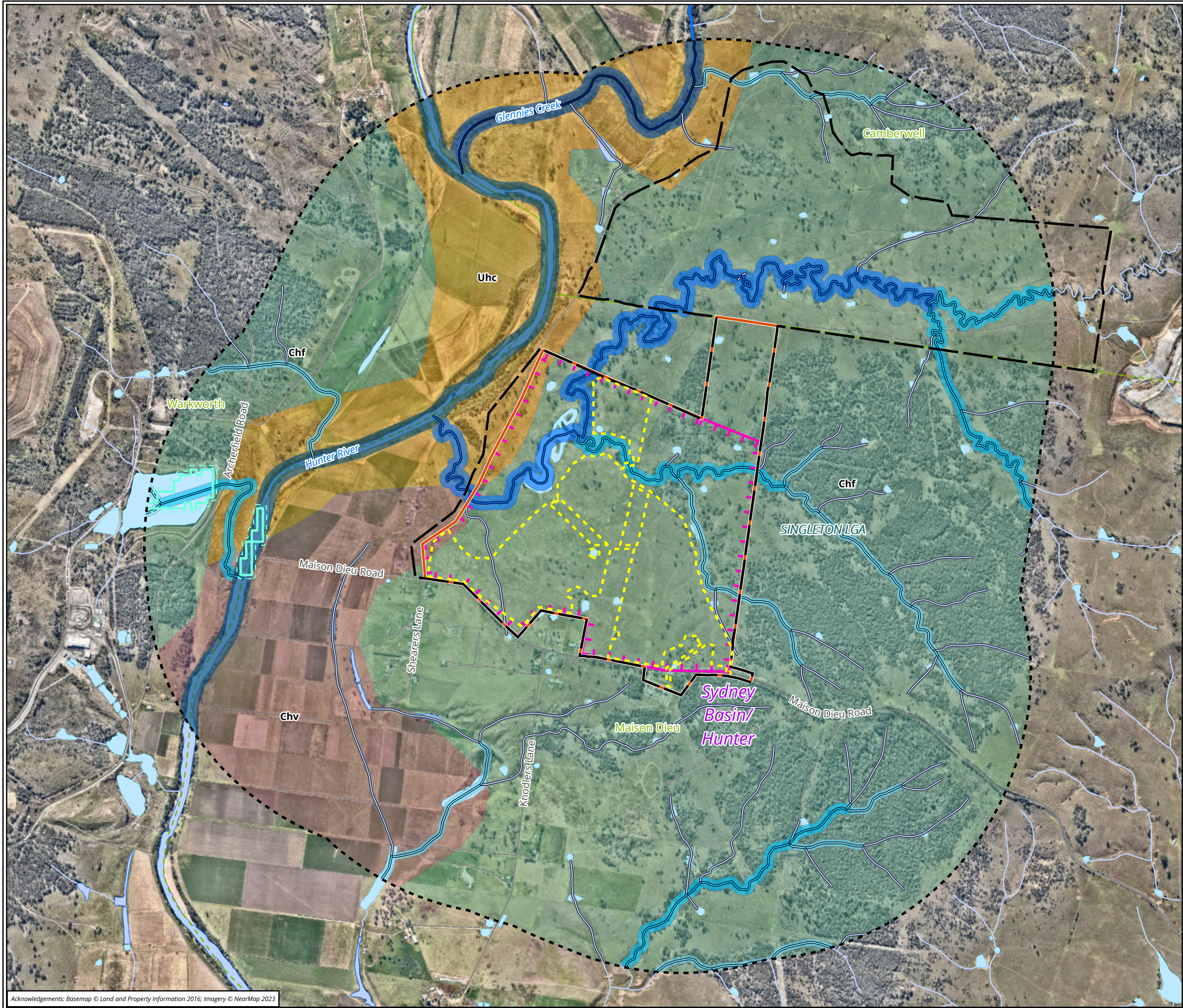
During the transitional period (until the entire Native Vegetation Regulatory (NVR) map is released), accredited assessors may establish the categorisation of land for the consent authority to consider by approximating the method used to make the NVR map under the provisions of the BC Act and the LLS Act. This is done via:

- Historical aerial imagery.
- Land use mapping:
 - The land use layer contributes to identifying land for inclusion in Category 1 in the NVR map. Chapter 4 of the NVR map method statement describes the process for identifying and mapping existing and historical agricultural land use since 1 January 1990. Mapping existing and historical land use focuses on identifying patterns or evidence of agricultural land uses according to high resolution aerial or satellite imagery and classifying land under a national land use classification system.
- Woody extent layer:
 - Contributes to identifying areas for inclusion in category 2 in the NVR map (including individual trees).
 - Latest publicly available is NSW Woody Vegetation Extent and FPC 2011 and 2017 update.
- Boundaries of sensitive regulated and vulnerable regulated land available on the NVR map portal.

The results of the land category assessment confirm that 36.2 hectares of the subject land and 29.9 ha within the disturbance footprint (within Lot 104 DP817010) contains Category 1 land (Figure 1). Prior to finalising the land category assessment, the draft NVR for the subject land was requested under licence from NSW DCCEEW and received on the 1 May 2023. Upon review, the draft NVR was consistent with the Biosis modelled assessment and demonstrates the distribution of Category 1 land across the subject land.

Final areas identified as non-native vegetation or Category 1-exempt land are shown in Figure 5 within Section 3.





Legend

- Subject land
- Study area
- Disturbance footprint
- Project area
- Assessment area
- IBRA Region/Sub-region
- Local wetlands
- Riparian buffers - Local wetlands

Strahler stream order

- 1
- 2
- 3
- 4
- 7

Strahler stream order buffers

- 1
- 2
- 3
- 4
- 7
- 9

Mitchell landscapes

- Chf, Central Hunter Foothills
- Chv, Central Hunter Alluvial Plains
- Uhc, Upper Hunter Channels and Floodplain

Figure 3 Location map



Meters
Scale: 1:19,000 @ A3
Coordinate System:
GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024,
GIS: JB, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\
38104_MaisonDieu_BDAR.aprx
Layout: 38104_F3_Location

3 Native vegetation

The subject land supports 194.26 hectares of native vegetation with varying levels of disturbance. Much of this (123.4 hectares) is in the form of derived native grasslands (DNG) with no native canopy cover and little to no shrub layer. Areas supporting woody native vegetation are largely restricted to the east of the subject land where connectivity to surrounding bushland is present. Outside of this, woody vegetation also occurs along the unnamed tributaries of the Hunter River and in small patches or single paddock trees.

3.1 Native vegetation and habitat assessment

3.1.1 Native vegetation extent

The extent of native vegetation, threatened ecological communities, and vegetation integrity within the subject land was determined using the results of site investigations and Section 4 of the BAM (DPIE 2020a).

Figure 4 provides a map of the native vegetation extent recorded within the subject land, as assessed during field investigations undertaken in October and December 2022 and January 2023. The figure includes all areas of native vegetation (native ground cover and areas with canopy) within the subject land. Areas not shown as native vegetation cover within Figure 4, are either devoid of all vegetation or considered Category 1 land (see Section 2.2).

3.1.2 Review of existing information

Existing information (DPE 2023b) regarding native vegetation within the subject land was reviewed to inform field investigations. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the subject land and disturbance footprint.

3.1.3 Field investigation of biodiversity values

A systematic biodiversity assessment was conducted from October 2022 through to January 2024 under the terms of Biosis' Scientific Licence issued by the Environment and Heritage Group (EHG) under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 May 2024). Fauna survey was conducted under approval from the Secretary's Animal Care and Ethics Committee (Secretary's ACEC) (expiry date 31 January 2028) and Animal Research Authority (ARA) 17/892 (expiry date 31 January 2025).

Assessment in accordance with the BAM was planned, overseen and partially carried out Accredited Assessor Brendon True (BAAS18155).

The subject land was surveyed in accordance with the BAM (DPIE 2020a), which involved:

- The identification and mapping of PCTs according to the structural definitions held in the BioNet Vegetation Classification database.
- Undertaking floristic plots within each vegetation zone in accordance with Section 4 of the BAM (DPIE 2020a), considering varying condition states and avoidance of ecotones, areas of disturbance, and edges.

- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002) with reference to recent taxonomic changes (Appendix 1).
- Incidental observations using the “random meander” method (Cropper 1993) (Appendix 2).
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the project area.
- An assessment of the natural resilience of the vegetation of the site.
- Identifying and mapping fauna habitats (e.g., hollow-bearing trees, rock outcropping etc.), assessing their condition and value to threatened fauna species, and considering threatened species’ habitat constraints.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- Targeted surveys for threatened fauna species.
- Targeted searches for plant species of conservation significance according to *Surveying Threatened Plants and Their Habitats* (DPIE 2020b) (disturbance footprint plus 50 metre buffer only).

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW
- EPBC Act for significance within Australia.

Detailed field mapping and collection of GPS point locations were conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab X) running the ArcGIS Field Maps application, using the inbuilt GPS, and aerial photo interpretation. Spatial locations are therefore considered to have an accuracy of generally ± 5 metres.

Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined and assigned. Identification of PCTs within the subject land was confirmed with reference to the community profile descriptors held within the BioNet Vegetation Classification database (NSW DCCEEW 2024). Locations of floristic plots surveyed are shown on Figure 6.

Further details of targeted survey for threatened flora and fauna species are provided in Section 4.2.1 below.

3.1.4 Local data

No local data has been used in the preparation of this BDAR.

3.1.5 Non-native vegetation

Some open paddock areas in the west of the subject land contain very low native vegetation cover and abundance. These areas align with those mapped as Category 1 land and this designation is used henceforth to reference these parts of the subject land. As detailed in Section 2.2, Category 1 land is not subject to full application of the BAM full, other than the additional biodiversity impacts in accordance with clause 6.1 of the BC regulation; (that being prescribed impacts) (Section 6.2).

3.1.6 Plant community types

The following PCTs were assessed as present within the subject land:

- PCT 3431 – Central Hunter Ironbark Grassy Woodland (Table 4).
- PCT 4015 – Central Hunter Swamp Oak Riparian Forest (Table 5).

Table 4 to Table 5 provide detailed descriptions of the two PCTs recorded within the subject land. PCTs recorded within the subject land are shown in Figure 5.

Table 4 PCT 3431 – Central Hunter Ironbark Grassy Woodland

PCT 3431 – Central Hunter Ironbark Grassy Woodland.	
Common name	Central Hunter Ironbark Grassy Woodland
Vegetation formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation class	Hunter-Macleay Dry Sclerophyll Forests
Extent within subject land	181.25 ha
Condition	This community at the subject land was recorded in the following condition states: • 30.09 ha of 3431_DNG_Low: DNG with low cover and abundance of native species. • 89.56 ha of 3431_DNG_Moderate: DNG with markedly higher cover and abundance of native species than 3431_DNG_Low. • 2.14 ha of 3431_High: A small section of fully structured forest with cover and abundance of native species. • 42.25 ha of 3431_Regen: Areas of forest with mature canopy and canopy regeneration. Generally lacking a consistent shrub layer. • 11.87 ha of 3431_Low: Patches of trees over DNG or single trees surrounded by Category 1 Land.
Description	Central Hunter Ironbark Grassy Woodland occurs in various condition states within the subject land, from a shrubby forest (3431_High) to areas of sparse tree cover (3431_Low) and DNG subject to grazing. Throughout these various conditions, Narrow-leaved Ironbark <i>Eucalyptus crebra</i> is consistently the dominant species, such that most wooded areas contain pure stands of the species. Other trees occurring far less frequently include Grey Box <i>E. moluccana</i> and Bulloak <i>Allocasuarina luehmannii</i>. Outside of 3431_High and small areas of 3431_Regen, an established shrub layer is lacking. Where this does occur, Fan Wattle <i>Acacia amblygona</i> grow densely. Other shrubs occurring infrequently throughout treed vegetation zones include Small-leaf Bluebush <i>Maireana microphylla</i>, Amulla <i>Eremophila debilis</i> and Narrawa Burr <i>Solanum cinereum</i>. Most often the understory is dominated by grasses, chiefly Purple Wiregrass <i>Aristida ramosa</i>, Red Grass <i>Bothriochloa macra</i>, Tall Chloris <i>Chloris ventricosa</i>, Common Couch <i>Cynodon dactylon</i>, Weeping Grass <i>Microlaena stipoides</i> and Slender Rat's Tail Grass <i>Sporobolus creber</i>. A diverse range of forbs are present at low cover including Common Woodruff <i>Asperula conferta</i>, Yellow Burr-daisy <i>Calotis lappulacea</i>, Common Everlasting <i>Chrysocephalum apiculatum</i>, Native Geranium <i>Geranium solanderi</i> and Native Pennyroyal <i>Mentha satuireioides</i>. Small, commonly occurring scramblers present include <i>Convolvulus graminetinus</i>, Slender Tick-trefoil <i>Desmodium varians</i> and Variable Glycine <i>Glycine tabacina</i>. One fern, Rock Fern <i>Cheilanthes sieberi</i>, was recorded. Vegetation zones 3431_High and 3431_Regen harbour fewer non-native species, however, the more historically disturbed vegetation zones contain a number of common occurring exotic grasses and herbs, most prevalent among them being <i>Setaria parviflora</i>,

PCT 3431 – Central Hunter Ironbark Grassy Woodland.	
	Fireweed <i>Senecio madagascariensis</i> , Lamb's Tongues <i>Plantago lanceolata</i> , Paspalum <i>Paspalum dilatatum</i> , Galenia <i>Galenia pubescens</i> and Prairie Grass <i>Bromus catharticus</i> .
Survey effort	Nineteen BAM plots (Figure 6)
Justification of PCT	PCT 3431 within the subject land meets the PCT description (NSW DCCEEW 2024) via the following: • Soil – occurs on the Blacktown soil landscape close to intergrades with the South Creek and Berkshire Park soil landscapes. • Rainfall – average annual rainfall below 750 mm. • Structure – open forest to woodland with a dense grassy groundlayer. • Dominant species – canopy dominated by Narrow-leaved Ironbark with Bullock and Grey Box as less frequent associates. Amulla, Small-leaf Bluebush and Fan Wattle in the midstory. • Geographical distribution – occurs between Rothbury, Wybong and Scone on the undulating floor of the Central Hunter Valley to the west of Newcastle. • IBRA region and subregion – Sydney Basin region and Hunter subregion.
TEC Status	• NSW BC Act: Associated with <i>Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions</i> (Endangered). The NSW Scientific Committees final determination for this TEC (DPE 2022a) notes that this TEC typically occurs as a woodland to open forest and does explicitly include degraded derived forms such as DNG. As such the following vegetation zones are considered to represent this TEC: • 3431_High: A small section of fully structured forest with cover and abundance of native species. • 3431_Regen: Areas of forest with mature canopy and canopy regeneration. Generally lacking a consistent shrub layer. • 3431_Low: Patches of trees only, single paddock trees not included. • Commonwealth EPBC Act: Associated with <i>Central Hunter Valley eucalypt forest and woodland</i> (Critically Endangered). EPBC Act TEC listings require a minimum condition threshold be met before a PCT can be considered a listed community. In this case of this community, derived forms are not included, then for treed areas, assessment of patch size, native species richness and understory condition (ratio of native flora versus exotic flora foliar cover) is required (DoE 2015). In summary, for a patch of PCT 3431 to be considered the listed community, it must: • Be at least 0.5 hectares in size, contain a perennial understory that is at least 50% native, and contain 12 native understory species, or • Be at least 2 hectares in size, and either: – Contiguous with, or near, another area of native woody vegetation that is at least 1 hectare in size, or at least one large, locally indigenous tree (at least 60 cm in diameter), or at least one tree with hollows. Patch size was determined via GIS and assessment of the above floristic characters undertaken where plot data was available to support analysis. Where plot data was not available, or information was lacking, the precautionary principle was applied. This process found that all 3431_High and 3431_Regen is considered <i>Central Hunter Valley eucalypt forest and woodland</i>. State and Commonwealth TECs are mapped on Figure 7.
Estimate of percent cleared value of PCT (BioNet)	86.47% (NSW DCCEEW 2024)

PCT 3431 – Central Hunter Ironbark Grassy Woodland.

**PCT_3431_DNG_Low
condition**



**PCT_3431_DNG_Moderate
condition**



PCT 3431_High condition



PCT 3431 – Central Hunter Ironbark Grassy Woodland.

**PCT 3431_Regen
condition**



PCT 3431_Low condition



Table 5 PCT 4015 – Central Hunter Swamp Oak Riparian Forest

PCT 4015 – Central Hunter Swamp Oak Riparian Forest	
Common name	Central Hunter Swamp Oak Riparian Forest
Vegetation formation	Forested Wetlands
Vegetation class	Coastal Floodplain Wetlands
Extent within subject land	18.35 ha
Condition	This community at the subject land was recorded in the following condition states: 9.97 ha of 4015_Moderate: Areas with near benchmark or higher tree cover. 8.38 ha of 4015_Low: Areas with lower than 50 % benchmark tree cover.
Description	Central Hunter Swamp Oak Riparian Forest with the subject land occurs in conjunction with two unnamed waterways. Two vegetation zones are present, distinguished by their degree of tree cover of which Swamp Oak <i>Casuarina glauca</i> is dominant with the occasional Narrow-leaved Ironbark and Rough-barked Apple <i>Angophora floribunda</i> also present. Native shrubs are all but absent, owing to sometimes dense growth of African Olive <i>Olea europaea</i> subsp. <i>Cuspidata</i> and to a lesser extent, African Boxthorn <i>Lycium ferocissimum</i>. The understory is grassy and dominated by a few species; Common Couch, Weeping Grass and Slender Rat's Tail Grass. Forbs, such as Lesser Joyweed <i>Alternanthera denticulata</i>, Kidney Weed <i>Dichondra repens</i> and Native Wandering Jew <i>Commelina cyanea</i>, occur sparsely throughout the grassy understory. In addition to African Olive and African Boxthorn, prevalent non-native species include Panic Veldt Grass <i>Ehrharta erecta</i>, <i>Setaria parviflora</i> and Paspalum.
Survey effort	One BAM plot (Figure 6).
Justification of PCT	PCT 4015 within the subject land meets the PCT description (DPE 2023b) via the following: - Structure – A tall Swamp Oak forest with a grassy ground layer. - Dominant species – canopy dominated by Swamp Oak, Kidney Weed, Weeping Grass and Common Couch in the understory. - Geographic distribution and landscape position – creek flats in the undulating terrain of the Central Hunter Valley to the west of Newcastle. Grades into PCT 3431 at higher positions. - IBRA region and subregion – Sydney Basin region and Cumberland subregion.
TEC Status	NSW BC Act: PCT 4015 is not associated with any TECs listed under the BC Act (NSW DCCEEW 2024). Commonwealth EPBC Act: Associated with <i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community</i>. EPBC Act TEC listings require a minimum condition threshold be met before a PCT can be considered a listed community. In this instance, tree canopy cover must be at least 10%. This has removed sparsely treed areas of 4015_Low from consideration. The remaining occurrence of PCT 4015 within the subject land, as it is part of a far larger patch of the PCT over 5 ha in size, understory cover need only be at least 20 % native with less than 50 % cover of transformer species, as coined by the approved Conservation Advice (DoEE 2018) for the TEC. At both locations where plot data was collected for PCT 4015, the above conditions are satisfied. Where plot data is not available, the precautionary principle has been applied. This process found that all 4015_Moderate and most 4015_Low is considered <i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community</i>.

PCT 4015 – Central Hunter Swamp Oak Riparian Forest	
	State and Commonwealth TECs are mapped on Figure 7.
Estimate of percent cleared value of PCT (BioNet)	87.87 % (DPE 2023b).
PCT 4015_Moderate condition	
PCT 4015_Low_condition	

3.1.7 Threatened ecological communities

Vegetation within the subject land was found to represent one TEC listed under the NSW BC Act, and two TECs listed under the Commonwealth EPBC Act, as outlined in Table 6 and Table 7 below and illustrated on Figure 7. Justification for the zones meeting the TEC criteria at both the state and federal levels, is discussed earlier in Section 3.1.6.

Table 6 Summary of BC Act TECs within the subject land

BC Act TEC	Listing status	Subject land (Ha)	Disturbance footprint (Ha)
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions (Central Hunter Grey Box Ironbark Woodland)	Endangered	56.26	10.79

Table 7 Summary of EPBC Act TECs within the subject land

EPBC Act TEC	Listing status	Subject land (Ha)	Disturbance footprint (Ha)
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	44.39	1.83
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community (Coastal Swamp Oak Forest)	Endangered	9.87	0.10

3.2 Vegetation integrity assessment

3.2.1 Vegetation zones and patch size class

PCTs within the subject land were assessed and stratified, based on broad condition state, into vegetation zones in accordance with Section 4.3 of the BAM, and as described in Table 4 to Table 5 above. This resulted in seven vegetation zones identified within the disturbance footprint. Table 8 describes each of the zones, and provides details on the numbers of BAM floristic plots undertaken in each zone.

Patch size classes for each vegetation zone present within the subject land were assessed as per Section 4.3.2 of the BAM (DPIE 2020a) using a select process in ArcGIS. All native vegetation with a gap of less than 100 metres from the next area of native vegetation (or ≤ 30 metres for non-woody ecosystems), is considered a single patch, with a patch able to extend onto adjoining land.

Native vegetation within the subject land was mapped sequentially and it was found to form part of a large patch of connecting vegetation with an area over 600 hectares.

Patch size classes for each vegetation zone are also outlined in Table 8 below.

Table 8 Vegetation zones within the subject land

Vegetation zone	Plant Community Type	Condition	BAM plots completed	Area (ha)	Max. patch size disturbance footprint
1	3431 – Central Hunter Ironbark Grassy Woodland	DNG_Low	4	30.10	≥ 100 ha
2	3431 – Central Hunter Ironbark Grassy Woodland	DNG_Moderate	5	89.56	≥ 100 ha
3	3431 – Central Hunter Ironbark Grassy Woodland	High	1	2.14	≥ 100 ha

Vegetation zone	Plant Community Type	Condition	BAM plots completed	Area (ha)	Max. patch size disturbance footprint
4	3431 – Central Hunter Ironbark Grassy Woodland	Regen	6	42.25	≥100 ha
5	3431 – Central Hunter Ironbark Grassy Woodland	Low	3	11.87	≥100 ha
6	4015 – Central Hunter Swamp Oak Riparian Forest	Moderate	1	8.38	≥100 ha
7*	4015 – Central Hunter Swamp Oak Riparian Forest	Low	0	9.97	≥100 ha

* - Benchmark data used at this vegetation zone would not be impacted.

3.2.2 Vegetation integrity

Vegetation integrity, or condition, was assessed using data obtained from undertaking BAM plots within the vegetation zones, as per Section 4.3.4 of the BAM (DPIE 2020a). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

In total, 23 BAM plots have been completed within the vegetation zones within the study area, details are provided in Table 9 and shown on Figure 6. Only plots located within the subject land have been entered into the BAM-C. Plot data was not collected within 4015_Low as this vegetation zone would not be impacted, therefore benchmark data has been used as surrogate.

Three of these 23 BAM plots included in the assessment are no longer located within the final disturbance footprint as a result of design refinements over the course of the Project. These plots have been retained for use in the assessment they are still considered to be representative of the vegetation present within the disturbance footprint.

Table 9 BAM plots completed within the study area

BAM plot reference	Vegetation zone	BAM plot reference	Vegetation zone
MSDF_01	3431_High	MSDF_13	4015_Moderate
MSDF_02	3431_Regen	MSDF_14	3431_Regen
MSDF_03	3431_DNG_Moderate	MSDF_15	3431_DNG_Moderate
MSDF_04	3431_DNG_Moderate	MSDF_16	3431_Low
MSDF_05*	3431_DNG_Low	MSDF_17	3431_DNG_Low
MSDF_06*	4015_Moderate	MSDF_18	3431_Regen
MSDF_07*	3431_DNG_Low	MSDF_19	3431_DNG_Moderate
MSDF_08	3431_Regen	MSDF_20	3431_Low
MSDF_09	3431_Regen	MSDF_21	3431_DNG_Low
MSDF_10	3431_DNG_Moderate	MSDF_22	3431_DNG_Low

BAM plot reference	Vegetation zone	BAM plot reference	Vegetation zone
MSDF_11	3431_Low	MSDF_23	3431_Regen
MSDF_12	3431_DNG_Low		
* - not entered into the BAM-C.			

Assessment of vegetation integrity was undertaken using standard benchmark data as outlined in the BAM and held in the BioNet Vegetation Classification database. A list of flora species was compiled for each BAM plot completed and is included in Appendix 3. Records of all flora species will be submitted to EHG for incorporation into the Atlas of NSW Wildlife.

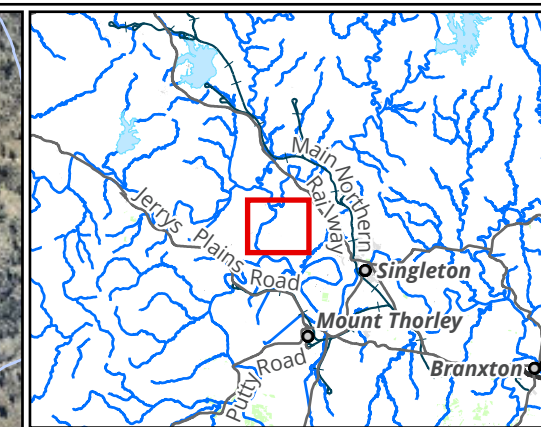
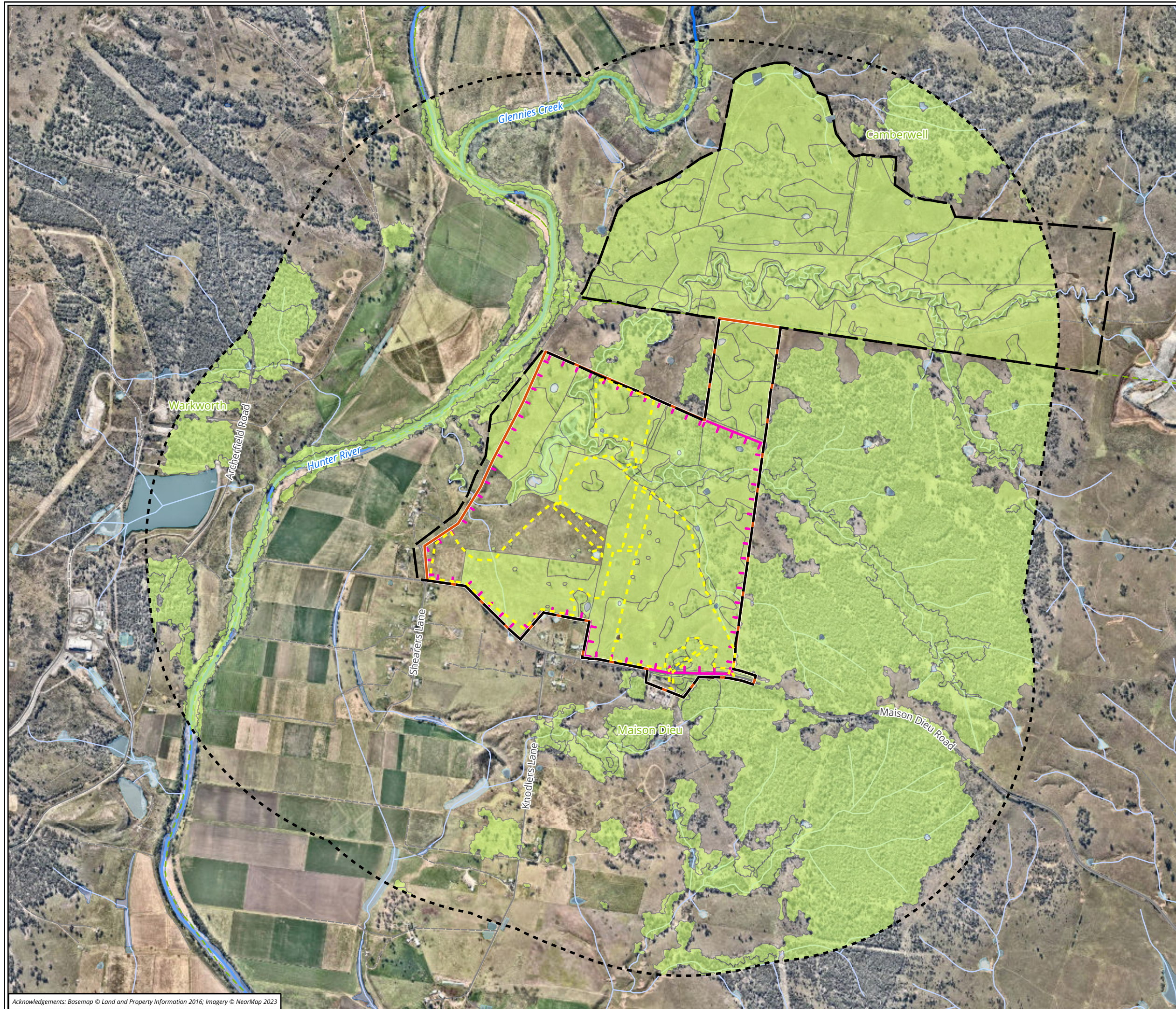
3.2.3 Vegetation integrity score

Plot data was entered into the BAM calculator to determine vegetation integrity score. Plot data are presented in Appendix 3, with vegetation integrity (VI) scores for each vegetation zones provided in Table 10.

Table 10 Vegetation zone integrity scores

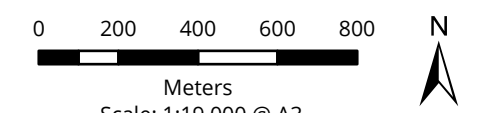
Vegetation zone	Composition score	Structure score	Function score	VI score*	Hollows present?
3431_DNG_Low	25.8	39.4	0.3	6.6	No
3431_DNG_Moderate	30.6	42.2	17.9	28.5	No
3431_High	74.2	46.1	76.4	63.9	Yes
3431_Regen	46.8	59.9	42.5	49.2	Yes
3431_Low	23.3	43.6	18.3	26.5	Yes
4015_Moderate	48	78.5	63.8	62.2	Yes
4015_Low*	100*	100*	100*	100*	Yes*

*Benchmark (pristine) condition vegetation would receive a VI score of 100.



- Legend**
- Subject land
 - Study area
 - Disturbance footprint
 - Assessment area
 - Project area

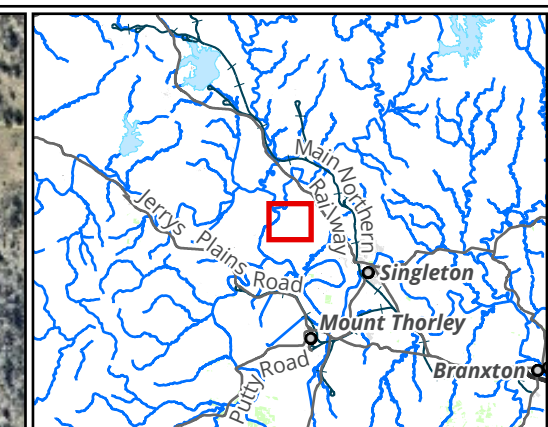
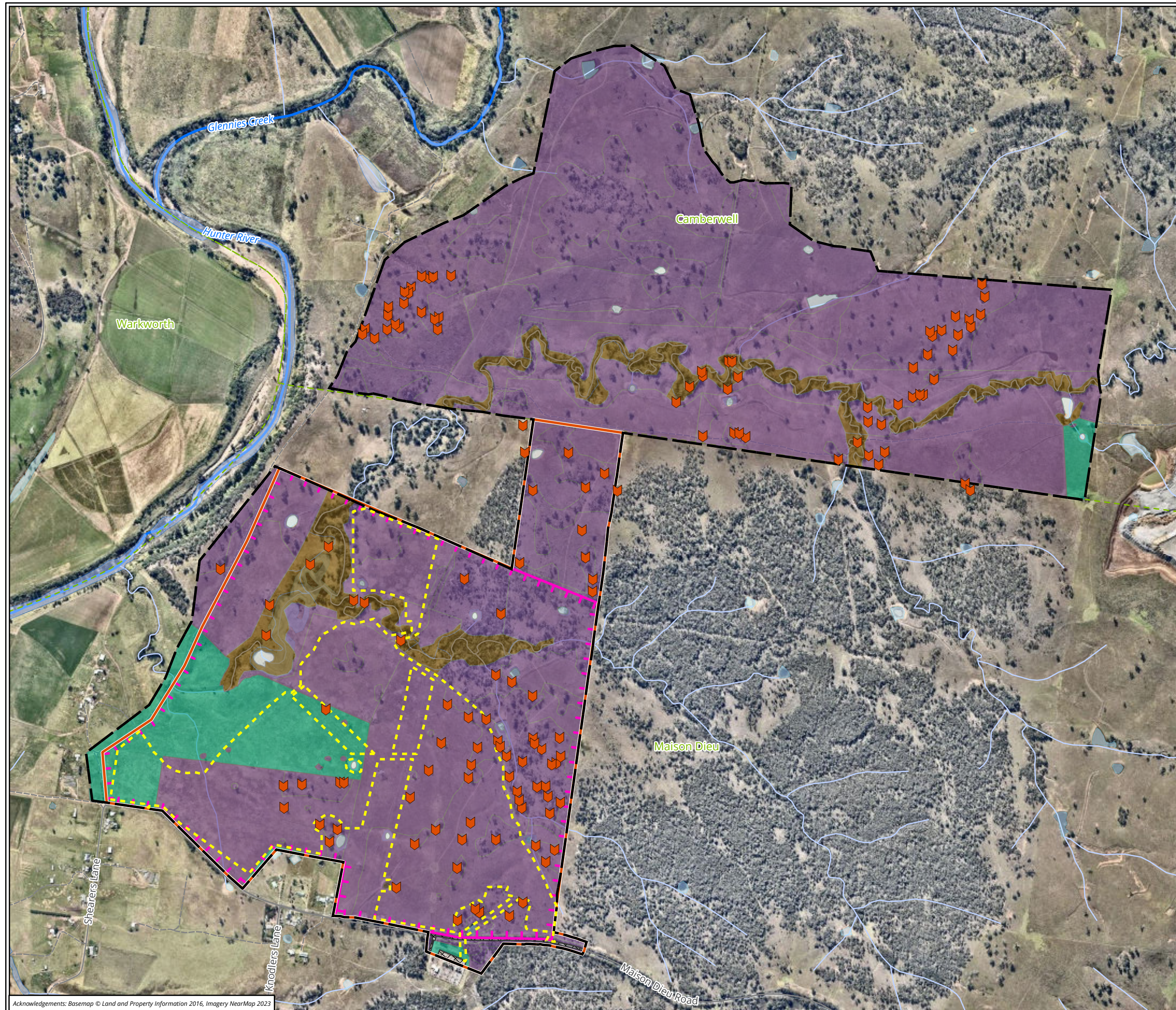
Figure 4 Native vegetation extent



Meters
Scale: 1:19,000 @ A3
Coordinate System:
GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024,
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\mapping\
38104_MaisonDieu_BDAR.aprx
Layout: 38104_F4_NativeVeg



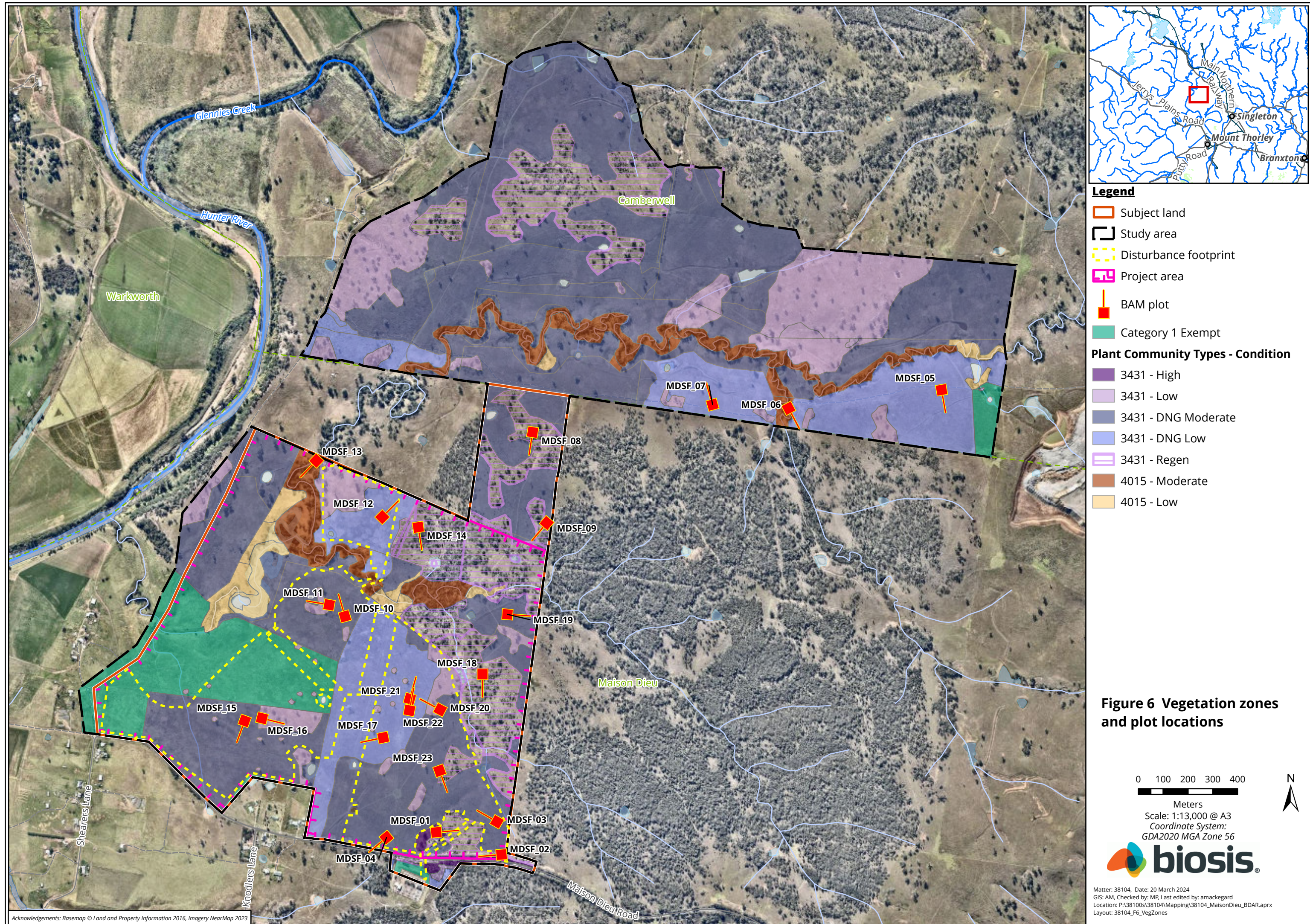
- Legend**
- Subject land
 - Study area
 - Disturbance footprint
 - Project area
 - Hollow-bearing tree
 - Cleared
 - Category 1 Exempt
- Plant Community Type**
- 3431 - Central Hunter Ironbark Grassy Woodland
 - 4015 - Central Hunter Swamp Oak Riparian Forest

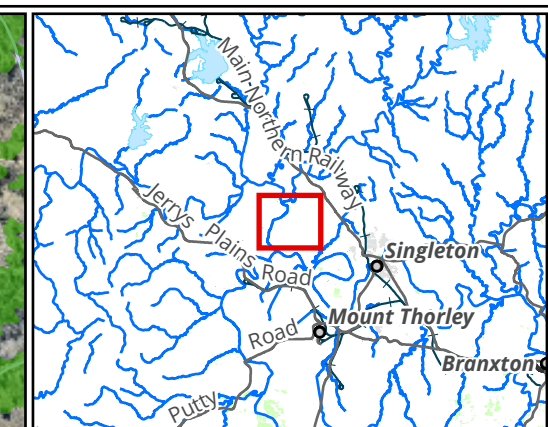
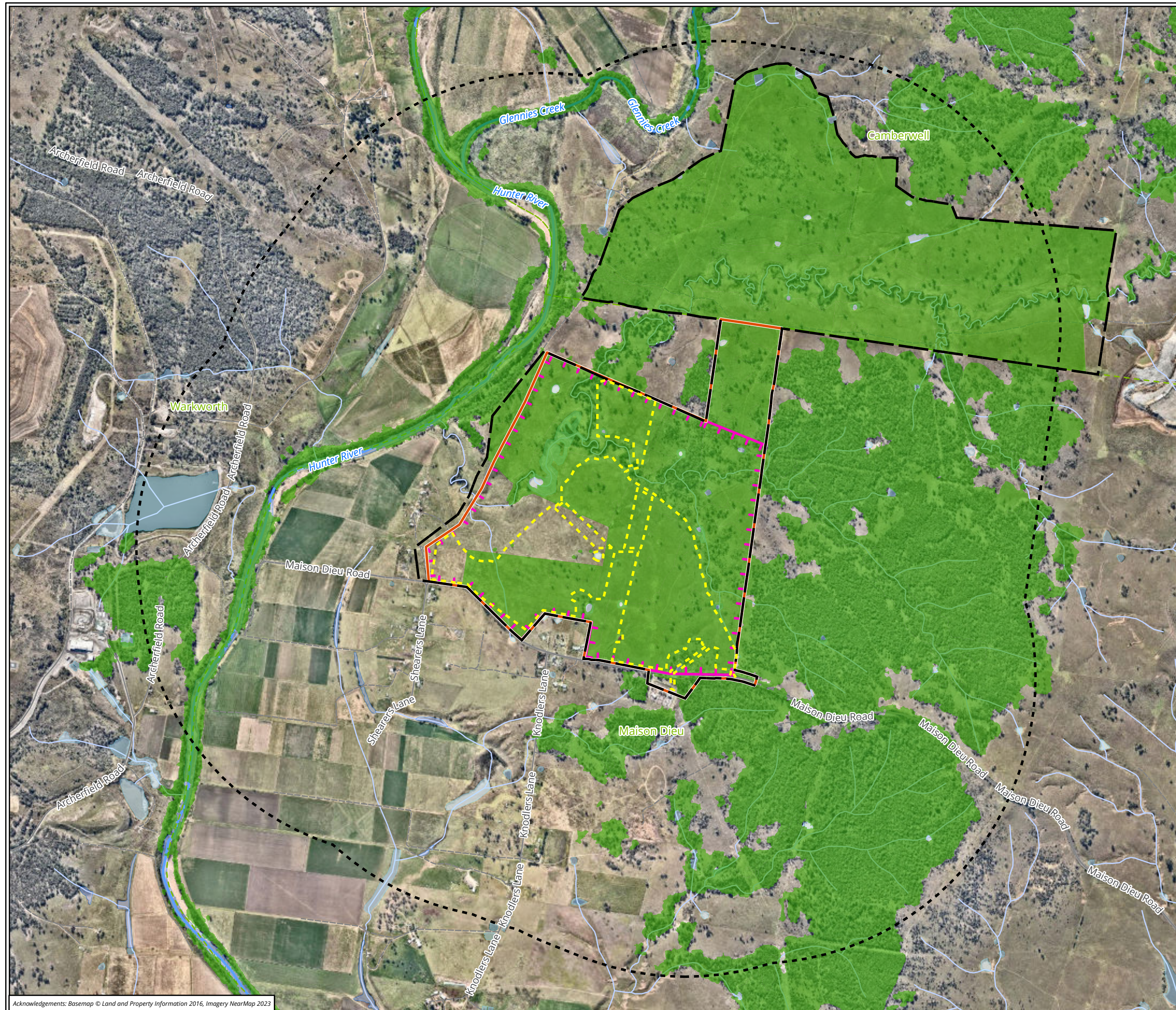
Figure 5 Vegetation within the study area

0 100 200 300 400
Meters
Scale: 1:13,000 @ A3
Coordinate System:
GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F5_BiosisVeg





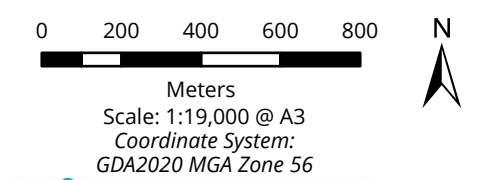
Legend

- Subject land
- Study area
- Development footprint
- Assessment area
- Project area

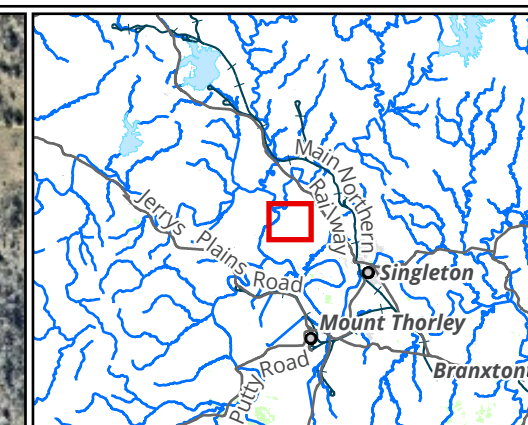
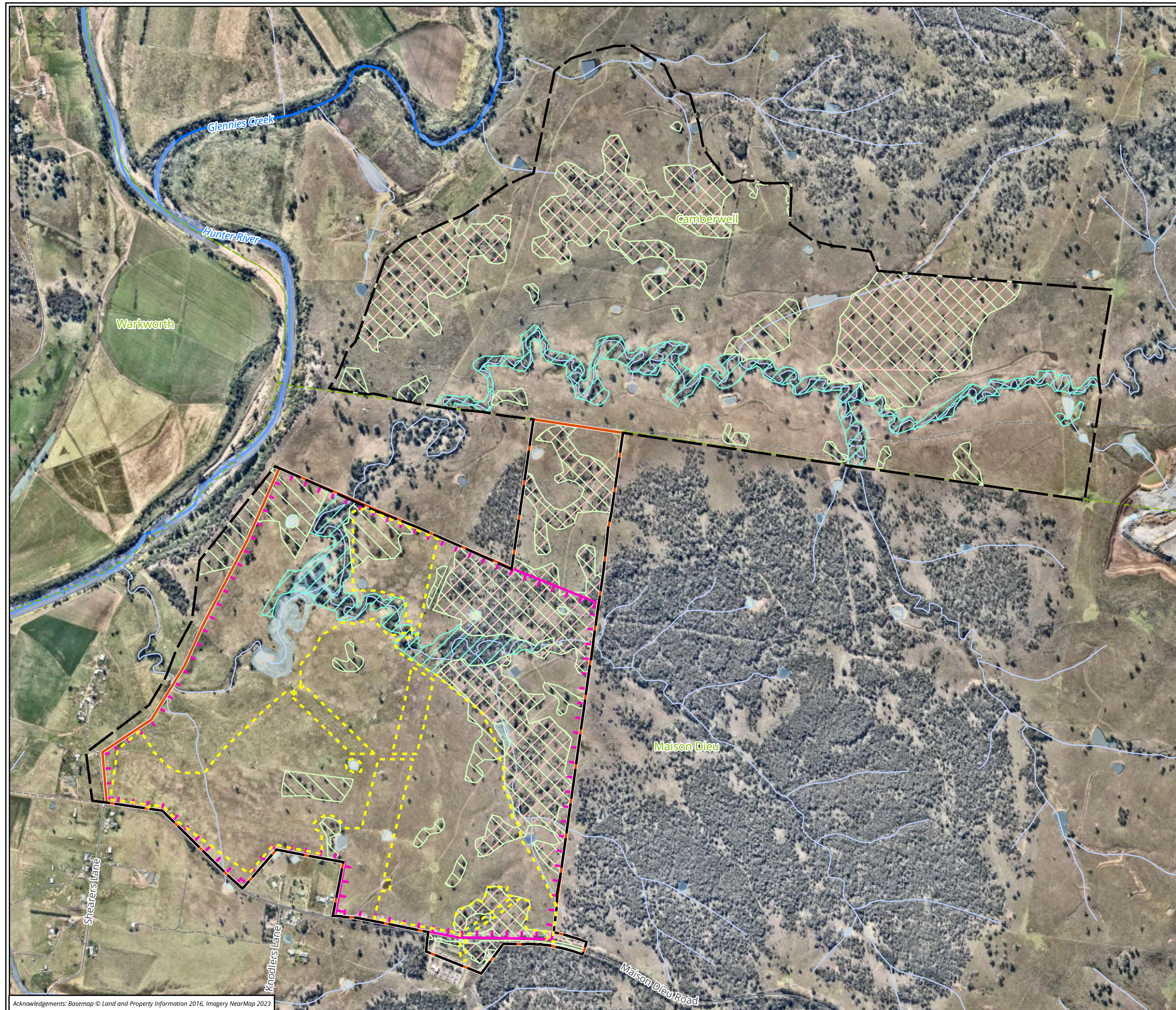
Patch size

- >100ha (3431 - High, Low, DNG)
- Moderate, DNG Low, Regen; 4015 - Moderate, Low)

Figure 7 Patch size



Matter: 38104, Date: 20 March 2024
 GIS: AM, Checked by: MP, Last edited by: amackegard
 Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
 Layout: 38104_F7_PatchSize



Legend

- Subject land
- Study area
- Disturbance footprint
- Project area

Threatened Ecological Communities

BC Act

- Central Hunter Grey Box Ironbark Woodland

EPBC Act

- Central Hunter Valley Eucalypt Forest and Woodland
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Figure 8 Threatened ecological communities within the study area

0 100 200 300 400

Meters

Scale: 1:13,000 @ A3

Coordinate System:

GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F8_TEC

4 Threatened species

4.1 Ecosystem credit species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was generated as per Section 5 of the BAM (DPIE 2020a). Impacts to these species require assessment, however targeted survey is not required as these species are assumed to occur, based on the occurrence of the PCTs, habitat constraints, native vegetation cover in the landscape and calculated patch sizes. These species are identified as ecosystem credit species in the Threatened Biodiversity Data Collection (TBDC). Table 11 lists the ecosystem credit species that could not be discounted, based on geographical restrictions or a lack of suitable habitat, from using the subject land on occasion.

These species were considered when prescribing management and mitigation measures for the Project, and a number have been specifically considered as part of the assessment under the Commonwealth EPBC Act.

Table 11 Ecosystem credit species (predicted species) with potential to occur

Common Name	Scientific Name
Australasian Bittern	<i>Botaurus poiciloptilus</i>
Australian Painted Snipe	<i>Rostratula australis</i>
Black Bittern	<i>Ixobrychus flavicollis</i>
Black Falcon	<i>Falco subniger</i>
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>
Broad-billed Sandpiper	<i>Limicola falcinellus</i>
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>
Diamond Firetail	<i>Stagonopleura guttata</i>
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>
Eastern Grass Owl	<i>Tyto longimembris</i>
Eastern Osprey	<i>Pandion cristatus</i>
Flame Robin	<i>Petroica phoenicea</i>
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>

Common Name	Scientific Name
Little Bent-winged Bat	<i>Miniopterus australis</i>
Little Eagle	<i>Hieraaetus morphnoides</i>
Little Lorikeet	<i>Glossopsitta pusilla</i>
Painted Honeyeater	<i>Grantiella picta</i>
Regent Honeyeater	<i>Anthochaera phrygia</i>
Scarlet Robin	<i>Petroica boodang</i>
Speckled Warbler	<i>Chthonicola sagittata</i>
Spotted Harrier	<i>Circus assimilis</i>
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>
Square-tailed Kite	<i>Lophoictinia isura</i>
Swift Parrot	<i>Lathamus discolor</i>
Turquoise Parrot	<i>Neophema pulchella</i>
Varied Sittella	<i>Daphoenositta chrysoptera</i>
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>
White-throated Needletail	<i>Hirundapus caudacutus</i>
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>

4.2 Species credit species

Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence, or components of their habitat. These species are identified as species credit species in the TBDC. A targeted survey or an expert report is required to confirm the presence of these species on the subject land, or alternatively the species can be assumed to be present (DPIE 2020a).

Appendix 4 provides the lists of species credit species predicted to occur within the subject land based on the IBRA subregion on which the Project occurs, the native vegetation cover present within the assessment area, the PCTs present within subject land, and patch sizes listed in Table 8.

The potential for a species to occur within the subject land was assessed in accordance with Section 5.2 of the BAM (DPIE 2020a) and species with geographical restrictions, or habitat constraints lacking were excluded from further assessment. Additionally, a number of species credit species were excluded from further assessment based on substantial degradation of existing potential habitat or lack of required microhabitat features.

The resulting list of species credit species considered to potentially occur within the subject land, and thus considered 'candidate species credit species' have been either assumed present or the subject of the target of threatened species surveys.

All species credit species considered as part of this assessment, and their associated method of assessment, are listed in Table 12 (flora species) and Table 13 (fauna species).

Threatened flora

Habitat for threatened flora within the subject land can broadly be categorised into two types:

- Type 1: Highly cleared areas with a more intense history of understory modification (pasture improvement) and grazing, including vegetation zones 3431_DNG_Low, 3431_DNG_Moderate and 3431_Low).
- Type 2: Areas of forest and woodland where historical disturbance appears to have been far less intense and the vegetation present is considerably more 'natural' in condition, including vegetation zones 3431_High, 3431_Regen and portions of 3431_DNG_Moderate that are connective between areas of 3431_Regen in the east of the subject land.

The list of threatened flora species the BAM-C generated for consideration is broad, ranging from trees to orchids. All these species have been retained as candidate species as they are considered to have the potential to occur within at least the Type 2 habitat described above. However, Type 1 habitat, and only a portion thereof, was considered suitable for a subset of the overall list and a targeted survey methodology was formulated accordingly.

Table 12 provides a list of candidate flora species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below. Note that no candidate flora species are associated with PCT 4015.

Table 12 Flora species credit species list generated by the BAM-C

Species name	Survey period	Method of assessment
<i>Acacia pendula</i> population in the Hunter catchment	All year	Targeted survey (Type 1 and Type 2 habitat)
<i>Cymbidium canaliculatum</i> population in the Hunter catchment	All year	Targeted survey (Type 1 and Type 2 habitat)
<i>Diuris tricolor</i> Pine Donkey Orchid	September – October	Targeted survey (Type 2 habitat)
<i>Diuris tricolor</i> – endangered population Pine Donkey Orchid population in the Muswellbrook local government area	September – October	Excluded based on geographic limitation.
<i>Eucalyptus glaucina</i> Slaty Red Gum	All year	Targeted survey (Type 1 and Type 2 habitat)
<i>Ozothamnus tessellatus</i>	September – October	Targeted survey (Type 2 habitat only)
<i>Persoonia pauciflora</i> North Rothbury Persoonia	All year	Excluded based on geographic limitation.
<i>Pomaderris queenslandica</i> Scant Pomaderris	All year	Targeted survey (Type 1 and Type 2 habitat)
<i>Prasophyllum petilum</i> Tarengo Leek Orchid	September – December	Targeted survey (Type 2 habitat only)
<i>Prasophyllum</i> sp. <i>Wybong</i>	September – October	Targeted survey (Type 2 habitat only)
<i>Pterostylis chaetophora</i>	September – November	Targeted survey (Type 2 habitat only)

Threatened fauna

Table 13 provides the list of fauna species credit species generated by the BAM-C and which are considered in this assessment. A small number were able to be excluded from further assessment by virtue of an obvious lack of habitat constraint or the subject land not fulfilling a noted geographic limitation.

The remaining species were subject to habitat assessment at minimum, and those species retained as candidate species subject to appropriate targeted surveys. Further detail of the habitat assessment and targeted surveys undertaken are provided in Section 4.2.1 below.

Table 13 Fauna species credit species list generated by the BAM-C

Species	Survey period	Method of assessment
Birds		
<i>Anthochaera phrygia</i> Regent Honeyeater	Not required	Excluded due to habitat constraint. The subject land is not within areas mapped as Important Habitat for this species, therefore, no further assessment is required.
<i>Burhinus grallarius</i> Bush Stone-curlew	All year	Habitat assessment in October and November 2022. Targeted survey in March and May 2023.
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	October – January	Habitat assessment in October and November 2022. Targeted survey in October and November 2022, March 2023.
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	January – September	Habitat assessment in October and November 2022. Targeted survey in October and November 2022, March 2023.
<i>Dromaius novaehollandiae</i> – endangered population Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	All year	Excluded due to geographic limitation. The subject land is not within the Port Stephens LGA, therefore no further assessment is required.
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	July – December	Habitat assessment in October and November 2022 to detect presence of potential nests. Species recorded foraging within the subject land during survey.
<i>Hieraaetus morphnoides</i> Little Eagle	August – October	Habitat assessment in October and November 2022 to detect presence of potential nests.
<i>Lathamus discolor</i> Swift Parrot	Not required	Excluded due to habitat constraint. The subject land is not within areas mapped as Important Habitat for this species, therefore, no further assessment is required.

Species	Survey period	Method of assessment
<i>Limicola falcinellus</i> Broad-billed Sandpiper (Breeding)	Not required	Excluded due to habitat constraint. The subject land is not within areas mapped as Important Habitat for this species, therefore, no further assessment is required.
<i>Lophoictinia isura</i> Square-tailed Kite	September – January	Survey conducted in December 2022 to detect presence of potential nests.
<i>Ninox connivens</i> Barking Owl	January – August	Habitat assessment in October and November 2022. Targeted survey in July 2023.
<i>Ninox strenua</i> Powerful Owl	January – August	Habitat assessment in October and November 2022. Targeted survey in July 2023.
<i>Pandion osprey</i> Eastern Osprey	April – November	Habitat assessment in October and November 2022 to detect presence of potential nests in nearby riparian habitats.
<i>Tyto novaehollandiae</i> Masked Owl	January – August	Habitat assessment in October and November 2022. Targeted survey in July 2023.
Mammals		
<i>Cercartetus nanus</i> Eastern Pygmy-possum	All year	Targeted survey in March and May 2023.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	December – January	Habitat assessment in October and November 2022. Targeted survey February / March 2023.
<i>Miniopterus australis</i> Little Bent-winged Bat	December – February	Habitat assessment in October and November 2022. Targeted survey February / March 2023.
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	December – February	Habitat assessment in October and November 2022. Targeted survey February / March 2023.
<i>Myotis macropus</i> Southern Myotis	October – March	Habitat assessment in October and November 2022. Targeted survey February / March 2023.
<i>Petauroides volans</i> Southern Greater Glider	All year	Targeted survey in March and May 2023.
<i>Petaurus norfolcensis</i> Squirrel Glider	All year	Targeted survey in March and May 2023.
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	All year	Habitat assessment in October and November 2022.
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	All year	Targeted survey in March and May 2023.
<i>Phascolarctos cinereus</i> Koala	All year	Targeted survey in March, May and November 2023.
<i>Planigale maculata</i> Common Planigale	All year	Habitat assessment in October and November 2022.

Species	Survey period	Method of assessment
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	All year	Habitat assessment in October and November 2022.
<i>Vespadelus troughtoni</i> Eastern Cave Bat	November – January	Habitat assessment and targeted survey in October and November 2022.
Amphibians		
<i>Litoria aurea</i> Green and Golden Bell Frog	November – March	Habitat assessment in October and November 2022.
Reptiles		
<i>Delma impar</i> Striped Legless Lizard	September – December	Habitat assessment in May 2023. Targeted survey August to December 2023.

4.2.1 Threatened species survey details

Targeted threatened species surveys of the subject land were undertaken from 27 October 2022 to 16 January 2024. Weather observations for each survey date are shown in Table 14. Note, SAT = Spot Assessment Technique.

Table 14 Weather observations during targeted flora and fauna surveys (Singleton, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
Diurnal bird survey (outside subject land)	27/10/22	15.1	27.3	0
Diurnal bird survey	28/10/22	16.4	31.2	0
Diurnal bird survey	07/11/22	13.1	25.6	0
Diurnal bird survey	08/11/22	12.8	30.9	0
Targeted flora	08/12/22	15.0	28.3	0
Acoustic detection (microbats)	23/02/23 – 17/03/23 (range provided)	13.9 – 24.3	23.5 – 37.2	0- 25
Spotlighting	27/03/23	16.1	21.9	0
Spotlighting	28/03/23	16.9	26.7	18.8
Spotlighting, diurnal bird survey	29/03/23	17.7	26.1	14.4
Spotlighting, diurnal bird survey	30/3/2023	13.5	25.2	3.8
Camera traps	02/05/23 – 31/05/23 (range provided)	2.3 – 11.3	16.6 – 23.5	0-8.6
Acoustic detection (owls)	10/07/23 – 21/07/23 (range provided)	1.2 – 10.2	17.4 – 22.9	0
Call playback (owls)	10/07/23	6.6	19.4	0

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
SAT, call playback (owls)	11/07/23	3.5	17.9	0
SAT, call playback (owls)	12/07/23	2.8	19.6	0
Call playback (owls)	13/07/23	3.4	21.5	0
Reptile survey	02/08/23	8	21.1	0
Targeted flora	05/10/23	10.9	22.7	0
SAT	7/11/23	11.3	27.4	0
SAT	13/11/23	17.3	26.1	0
SAT	14/11/23	13.5	33.8	0
Targeted flora	16/01/24	18.3	26.4	0.4

Information from the Australia Government Bureau of Meteorology website.

Details of surveys undertaken as part of the current assessment are provided below.

Threatened Flora

Survey method and effort

Habitat for candidate flora species within the subject land was broadly stratified into two habitat types, Type 1 and Type 2 (as described in Section 4.2). For the purposes of conducting targeted flora surveys, a survey area equivalent to the disturbance footprint plus a varying buffer of minimum 50 metres was utilised within Type 2 habitat. This area was formulated with a view to satisfactorily assess the potential for the Project to directly and / or indirectly impact any candidate flora species.

Within Type 2 habitat, that is vegetation zones 3431_High, 3431_Regen and portions of 3431_DNG_Moderate, the methods utilised for smaller growth forms were minimum 10 metre separated parallel field traverses reduced to five metres where dense vegetation was encountered. Larger growth forms were surveyed using wider traverses of up to 30 metre separation. Although primarily all Type 2 habitat was targeted, where areas of Type 2 habitat are separated by small areas of Type 1 habitat in the south-east of the subject land, these connecting areas were also subject to parallel field traverses.

Note that given their nature, *Cymbidium canaliculatum* (a large, epiphytic orchid) and Slaty Red Gum were not surveyed for in Type 1 habitat using the above method. Rather, each tree within Type 1 habitat was surveyed individually to detect the presence of these species.

Given seasonal limitations and the number of targeted species, three rounds of survey were undertaken (December 2022, October 2023 and January 2024).

Justification of survey method and effort

As stated above, all targeted flora survey was undertaken to the required method and effort under the BAM and within the habitat present in the subject land.

Timing of survey

Five of the candidate flora species assessed in this BDAR have seasonal survey requirements as detailed by the TBDC:

- Pine Donkey Orchid
- *Ozothamnus tessellatus*
- Tarengo Leek Orchid
- *Prasophyllum* sp. Wybong
- *Pterostylis chaetophora*

As four of the five above species are orchids and not detectable unless in flower, knowledge of the flowering of reference populations of each species was used to optimise survey timing for this assessment. This involved correspondence with officers working in the NSW Saving our Species program for each species. From this correspondence, it was determined that early October 2023 was the most suitable survey period for the above orchids. This timing is also suitable for detection of *Ozothamnus tessellatus*.

The remaining five candidate flora species do not have a survey period listed in the TBDC and can be surveyed for all year round.

Survey personnel and relevant experience

Targeted flora surveys were undertaken by the Biosis ecologists listed in Table 15.

Table 15 Targeted flora survey personnel and relevant experience

Staff member	Role	Relevant experience
Brendon True	Senior Botanist	Over 12 years' botanical survey experience concentrating on the Hunter region since 2018.
Brooke Corrigan	Senior Botanist	Over 15 years' botanical survey experience concentrating on the Hunter region.

Results

Table 16 provides a summary of the results of the targeted flora surveys completed.

Table 16 Summary of targeted flora survey method and results

Species	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Acacia pendula</i> population in the Hunter catchment	Grid based searches and parallel field traverses.	Not detected	NA
<i>Cymbidium canaliculatum</i> population in the Hunter catchment	Parallel field traverses, survey of each tree within Type 1 habitat.	Not detected	NA
<i>Diuris tricolor</i>	Parallel field traverses.	Not detected	NA

Species	Survey method	Survey results	Species Polygon (ha) or count within the subject land
Pine Donkey Orchid			
<i>Eucalyptus glaucina</i> Slaty Red Gum	Parallel field traverses, survey of each tree within Type 1 habitat.	Not detected	NA
<i>Ozothamnus tessellatus</i>	Parallel field traverses.	Not detected	NA
<i>Pomaderris queenslandica</i> Scant Pomaderris	Grid based searches and parallel field traverses.	Not detected	NA
<i>Prasophyllum petilum</i> Tarengo Leek Orchid	Parallel field traverses.	Not detected	NA
<i>Prasophyllum sp. Wybong</i>	Parallel field traverses.	Not detected	NA
<i>Pterostylis chaetophora</i>	Parallel field traverses.	Not detected	NA

Limitations

The targeted flora survey undertaken for this BDAR is not considered to have any critical limitations that might diminish the validity of the above results. Efforts were made to ensure all candidate flora species with seasonal survey requirements were detectable at the time of survey, particularly orchids.

Fauna habitat assessments

Fauna habitat assessment was undertaken to determine the presence of microhabitats and other critical habitat components (habitat constraints) suitable for all fauna species outlined in Table 13 and Appendix 4. Habitat assessments focussed on the presence of the following features within the subject land:

- Habitat trees including large and/or hollow-bearing trees, stick nests, availability of flowering shrubs and canopy/understorey feed tree species.
- Soil type and presence of cliffs, overhangs and other rocky areas.
- Condition and type of native vegetation and the presence of exotic species.
- Presence and condition of pools and waterways.
- Quantity of ground litter and woody debris.
- Searches for indirect evidence of fauna (i.e. feathers, tracks and scats).
- General degradation of the site as a result of past and current disturbances such as vegetation clearing and industrial land management practices.
- Topography and landscape morphology.
- Presence of flying-fox camps.

Several habitat features with potential to support threatened species credit species were identified during these habitat assessments. These features have been summarised in Table 17.

Table 17 Habitat features with potential to support threatened species credit species

Habitat feature	Presence within the disturbance footprint
Habitat trees	Habitat trees supporting hollows of a variety of size classes from small (<50 mm diameter) through to extra-large (> 400 mm diameter) were present across the subject land. These trees have the potential to provide breeding resources for a range of native fauna species including threatened cockatoos (Glossy Black-Cockatoo and Gang-gang Cockatoo), owls (Barking Owl, Masked Owl, and Powerful Owl), microbats and arboreal mammals (Squirrel Glider, Southern Greater Glider, Eastern Pygmy-possum) and Brush-tailed Phascogale. No stick nests that may be used by the threatened raptors assessed were observed.
Feed tree species	Koala use trees within the Central Coast Koala management area, which includes the subject land, were detected during the assessment. These trees also provide food resources for smaller mammals such as Eastern Pygmy-possum and Squirrel Glider, however, shrubs that provide resources for such species are generally lacking.
Caves and rocky overhangs	The subject land was not found to contain any caves or rocky overhangs that may provide potential breeding habitat for threatened microbats including Large-eared Pied Bat, Little Bent-winged Bat, Large Bent-winged Bat, Southern Myotis Eastern Cave Bat.
Rocky outcrops and sandstone crevices	Geological features of note within the subject land are generally lacking given its position on a plain and foothill. No noteworthy crevices are present and surface rock is limited to small areas within 3431_High and 3431_Regen in the southeast. These areas, and indeed much of the grassland, serves as potential habitat for Striped Legless Lizard. Given the lack of rocky outcrops, habitat is not considered present for Brush-tailed Rock Wallaby.
Major and minor watercourses and waterbodies (i.e. dams)	The subject land does not contain any major, or named watercourses, however, 3rd and 4th order streams (Strahler 1964) are present that are tributaries of the Hunter River to the west. All are characterised by a high degree of ephemerality, particularly the lower order waterways. Most watercourses have eroded banks and lack 'natural' riparian zones. Nutrient enrichment has also led to poor water quality generally. As such, none of the watercourse present are considered to provide long-term, viable habitat for Green and Golden Bell Frog, A number of artificial waterbodies (dams) are present within the subject land, many of which are situated to capture water that would otherwise flow into the watercourses described above. Though they are ephemeral and appear to only be fed by rainwater drainage, some contain fringing macrophytes indicating that they are likely to maintain some longer periods containing water. However, due to poor water quality, high degree of ephemerality and lack of connectivity to suitable habitat, these dams are not considered viable habitat for Green and Golden Bell Frog.
Woody debris	Woody debris, though not prolific, is present within wooded vegetation zones within the subject land. Coarse woody debris is noted in the TBDC as the habitat constraint for Bush-stone Curlew.
Man-made structures	The subject land does not contain any man-made structures that may be used as habitat by any candidate microbat species.

Generally, the subject land contains habitat for a raft of different non-threatened fauna species including Long-nosed Bandicoot *Perameles nasuta*. However, such species are not required to be assessed the BAM and impact to such species will be minimal.

Field capture of detailed fauna habitat information allowed for confirmation of presence of habitat features and microhabitats for a range of candidate threatened species across the subject land. Fauna habitat assessments were captured using ArcGIS points and polygons attributed with specific habitat criteria that allowed for planning of further targeted survey for select species, or the exclusion of the potential for occurrence of various species credit species from the subject land.

Table 18 Species credit species retained as candidate species and those excluded from further assessment

Species	Survey period	Method of assessment
Birds		
<i>Burhinus grallarius</i> Bush Stone-curlew	All year	Habitat assessment in October and November 2022. Targeted survey in March 2023.
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	October – January	Targeted survey in October and November 2022, March 2023.
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	January – September	Targeted survey in October and November 2022, March 2023.
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	July – December	Targeted survey and habitat assessment in October and November 2022 did not identify any potential nest trees. No incidental sightings in all other surveys.
<i>Hieraaetus morphnoides</i> Little Eagle	August – October	Targeted survey and habitat assessment in October and November 2022 did not identify any potential nest trees. No incidental sightings in all other surveys.
<i>Lophoictinia isura</i> Square-tailed Kite	September – January	Targeted survey and habitat assessment in October and November 2022 did not identify any potential nest trees. No incidental sightings in all other surveys.
<i>Ninox connivens</i> Barking Owl	May – December	Habitat assessment in October and November 2022. Targeted survey in July 2023.
<i>Ninox strenua</i> Powerful Owl	May – August	Habitat assessment in October and November 2022. Targeted survey in July 2023.
<i>Pandion osprey</i> Eastern Osprey	April – November	Targeted survey and habitat assessment in October and November 2022 did not identify any potential nest trees. No incidental sightings in all other surveys.
<i>Tyto novaehollandiae</i> Masked Owl	May – August	Habitat assessment in October and November 2022. Targeted survey in July 2023.
Mammals		
<i>Cercartetus nanus</i> Eastern Pygmy-possum	All year	Targeted survey in March and May 2023.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	December – January	Targeted survey February / March 2023.

Species	Survey period	Method of assessment
<i>Miniopterus australis</i> Little Bent-winged Bat	December – February	Targeted survey February / March 2023.
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	December – February	Targeted survey February / March 2023.
<i>Myotis macropus</i> Southern Myotis	October – March	Targeted survey February / March 2023.
<i>Petauroides volans</i> Southern Greater Glider	All year	Targeted survey in March and May 2023.
<i>Petaurus norfolcensis</i> Squirrel Glider	All year	Targeted survey in March and May 2023.
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	All year	Excluded as habitat assessment in October and November 2022 did not identify this species habitat constraint.
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	All year	Targeted survey in March and May 2023.
<i>Phascolarctos cinereus</i> Koala	All year	Targeted survey in March, May and November 2023.
<i>Planigale maculata</i> Common Planigale	All year	Excluded as subject land lacks suitable microhabitat and is outside known distribution.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	All year	Habitat assessment in October and November 2022 did not identify this species habitat constraint (breeding camps).
<i>Vespadelus troughtoni</i> Eastern Cave Bat	November – January	Targeted survey February / March 2023.
Amphibians		
<i>Litoria aurea</i> Green and Golden Bell Frog	November – March	Excluded as habitat assessment in October and November 2022 did not identify suitable habitat for this species.
Reptiles		
<i>Delma impar</i> Striped Legless Lizard	September – December	Habitat assessment in May 2023. Targeted survey August to December 2023.

Nocturnal birds

Targeted nocturnal bird surveys were undertaken for:

- Bush Stone-curlew *Burhinus grallarius*
- Barking Owl *Ninox connivens*

- Powerful Owl *Ninox strenua*
- Masked Owl *Tyto novaehollandiae*

Survey method and effort

Surveys were repeated over four nights and included:

- Habitat searches.
- Call playback and flushing surveys during spotlighting for Bush-stone Curlew.
- Call playback and detection in suitable habitat for threatened owls over four nights, including a two-minute call playback, followed by five minutes of listening, and two minutes of spotlighting (conducted twice) per species, with an initial ten-minute listening period and two-minute spotlighting period before commencing; plus a final ten minute listening period following the survey. One call playback point was undertaken.
- Two acoustic monitoring devices, audiomoths, were also trialled during the surveys and recorded for 14 nights each.

Justification of survey method and effort

Survey guidelines followed included:

- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a).
- *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004).

It should be noted that in March 2024, the BAM-C and TBDC were updated with new guidance and data regarding forest owls. Given survey for forest owls for this BDAR were conducted in July 2023, they are a departure from the most recent guidance in the way broadcasting calls, listening and searches are sequenced, however is still considered appropriate. The use of audiomoths is also now an approved method.

Timing of survey

Survey was conducted in relation to requirements in the TBDC survey guides.

Survey personnel and relevant experience

Nocturnal bird surveys were undertaken by the Biosis ecologists outlined in Table 19.

Table 19 Targeted nocturnal bird survey personnel and relevant experience

Staff member	Role	Relevant experience
Caragh Heenan	Senior Zoologist	Over four years' experience undertaking nocturnal bird surveys in NSW and 16 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Emma Heath	Graduate Ecologist	Over one year of experience undertaking flora and fauna surveys in NSW.

Results

Table 20 provides a summary of the results of the nocturnal bird surveys completed. In addition to the below, one mature Barn Owl *Tyto alba* was recorded within the subject land during multiple nights of survey. Photo

analysis of this individual by senior zoologists confirmed the Barn Owl observation, and not the presence of a Masked Owl. One Powerful Owl was heard responding to call playback on one night within adjacent vegetation, however further searches did not detect this individual within the subject land.

As noted above, updated guidance relating to how forest owls are assessed under the BAM was released in March 2024. This included the way in which species polygons are required to be drawn. These changes have been applied in Table 20 below and all subsequent relevant sections in this BDAR.

Table 20 Summary of nocturnal bird survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Burhinus grallarius</i>	Bush Stone-curlew	27-30 March 2023: Habitat searches and spotlighting, flushing surveys. 10-13 July 2023: Incidental call detection repeated over four nights at one location.	Not recorded during surveys.	N/A
<i>Ninox connivens</i>	Barking Owl	27-30 March 2023: Habitat searches and spotlighting. 10-13 July 2023: Call detection in suitable habitat, repeated over four nights at one location.	Not recorded during surveys.	N/A
<i>Ninox strenua</i>	Powerful Owl	27-30 March 2023: Habitat searches and spotlighting. 10-13 July 2023: Call detection in suitable habitat, repeated over four nights at one location.	Response by one individual on one evening following call playback for the species. The individual could not be located, therefore a position was estimated based on call on direction and volume.	A species polygon, covering 32.94 ha was drawn to include all vegetation zones within 800 m of the estimated location containing a living or dead tree with a hollow >20 cm diameter that occurs >4 m above the ground.
<i>Tyto novaehollandiae</i>	Masked Owl	27-30 March 2023: Habitat searches and spotlighting. 10-13 July 2023: Call detection in suitable habitat, repeated over four nights at one location.	Not recorded during surveys.	N/A

Limitations

Survey guidance for forest owls released in March 2024 require call playback surveys be conducted over six separate nights, however survey was ceased following the fourth replicate. To supplement additional survey nights, two acoustic monitoring devices, audiomoths, were in place for 14 nights each, with only common avifauna species audible following analysis.

Diurnal birds

Targeted diurnal bird surveys were undertaken for:

- Gang-gang Cockatoo *Callocephalon fimbriatum*
- Glossy Black Cockatoo *Calyptorhynchus lathamii*

Survey method and effort

The targeted survey approach for South Eastern Glossy Black Cockatoo and Gang-gang Cockatoo followed the 1 hectare 20 minute search method (Loyn et al. 1986). Surveys were repeated on numerous occasions, dependent on species requirements, and included:

- Three repetitions (minimum) of 1 ha 20 minute area search (Loyn et al. 1986).
- Habitat searches, to identify large stick nests or birds returning to hollow-bearing trees.

Through the completion of tasks such as vegetation mapping, habitat mapping, plot data collection, equipment set up and retrieval and targeted flora survey, a significant amount of incidental survey has also been undertaken across the subject land and study area. Although not all incidental survey was undertaken within the prescribed survey periods for both species, they can generally be detected all year round such that incidental survey is considered to complement the targeted survey undertaken, and add confidence to the findings of this assessment.

Justification of survey method and effort

NSW DCCEEW is developing survey guidance for many threatened bird species (DPE 2023d). Currently, for both target cockatoo species, the TBDC stipulates a staged approach for the detection of breeding. This includes first looking for signs of breeding (presence of the species during breeding season) which if detected, is follow up by identification of potential nest trees (suitable hollow-bearing trees or stick nests).

In this instance, as no signs of breeding of either species were detected, no monitoring of potential nest trees was required.

Survey guidelines followed included:

- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a).
- *Threatened Biodiversity Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004).

Timing of survey

The targeted survey undertaken in March 2023 for South Eastern Glossy Black Cockatoo was within the period (January – September) prescribed the TBDC. Similarly, the targeted survey undertaken for Gang-gang Cockatoo in October and November 2022 was within the prescribed period (October – January) for this species. Stick nest searches for raptors was undertaken in October and November 2022, which was within the

prescribed period for all species, with exception for Little Eagle. Little Eagle surveys were undertaken 28 October and 7-8 November 2022, however only one replicate survey was undertaken during the prescribed survey period (August to October), and the remaining two were conducted in a shoulder period. Initial field investigation was undertaken in October 2022, therefore opportunistic sightings of large stick nests and individuals would have been possible during this time.

Survey personnel and relevant experience

Diurnal bird surveys were undertaken by the Biosis ecologists outlined in Table 21.

Table 21 Targeted diurnal bird survey personnel and relevant experience

Staff member	Role	Relevant experience
Dr Caragh Heenan	Senior Zoologist	Over four years' experience undertaking bird surveys in NSW and 16 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Julia Hutton	Graduate Ecologist	Over two years of experience undertaking fauna surveys in NSW.

Results

Table 22 provides a summary of the results of the diurnal bird surveys completed.

Table 22 Summary of diurnal bird survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	- Habitat searches. 28 October 2022, 7-8 November 2022: Transect searches (1 ha 20 minute area search) through areas containing large hollow-bearing trees. 27 October 2022: Additional transect searches outside of the subject land to the north.	Not recorded during surveys.	N/A
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	- Habitat searches. 29-30 March 2023: Transect searches (1 ha 20 minute area	Not recorded during surveys.	N/A

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Haliaeetus leucogaster</i>		search) through areas containing large hollow-bearing trees. 27 October 2022: Additional transect searches outside of the subject land to the north.		
	White-bellied Sea-Eagle	28 October 2022, 7-8 November 2022: Transect searches (1 ha 20 minute area search) through suitable habitat, repeated on three occasions (minimum) searching for large stick nests. 27 October 2022: Additional transect searches outside of the subject land to the north.	One individual recorded during surveys, however no breeding nests identified.	N/A
<i>Hieraaetus morphnoides</i>	Little Eagle	28 October 2022, 7-8 November 2022: Transect searches (1 ha 20 minute area search) through suitable habitat, repeated on three occasions (minimum) searching for large stick nests. 27 October 2022: Additional transect searches outside of the subject land to the north.	Not recorded during surveys.	N/A

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Lophoictinia isura</i>	Square-tailed Kite	28 October 2022, 7-8 November 2022: Transect searches (1 ha 20 minute area search) through suitable habitat, repeated on three occasions (minimum) searching for large stick nests. 27 October 2022: Additional transect searches outside of the subject land to the north.	Not recorded during surveys.	N/A
<i>Pandion cristatus</i>	Eastern Osprey	28 October 2022, 7-8 November 2022: Transect searches (1 ha 20 minute area search) through suitable habitat, repeated on three occasions (minimum) searching for large stick nests. 27 October 2022: Additional transect searches outside of the subject land to the north.	Not recorded during surveys.	N/A

Limitations

Surveys for Little Eagle were undertaken partially outside of the prescribed survey period for the species, as outlined in Timing of survey section above. Additional field investigations were undertaken in October 2022, and no evidence of breeding was recorded.

Reptiles

Targeted reptile surveys were undertaken for Striped Legless Lizard *Delma impar*.

Survey method and effort

Habitat assessment for Striped Legless was conducted in May 2023 whereby suitable habitat (species polygon) for the species was mapped across the subject land. Subsequent targeted survey was carried out through a combination of habitat searches (searching around tussocks and turning over rocks) and installation of artificial cover boards was used. Habitat surveys were conducted across two person hours weekly for eight weeks, focusing on areas with surface rock and highest suitability. As the area of suitable habitat for Striped Legless Lizard was deemed to be within 30-50 hectares initially, with 10 tile grids of 50 roof tiles each (500 tiles total) installed in August 2023. Tiles were checked weekly for eight weeks concurrently with habitat searches from October to December 2023.

Justification of survey method and effort

Survey guidelines followed included:

- *Threatened reptiles – Biodiversity Assessment Method survey guide* (DPE 2022b).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).
- *Survey Guidelines for Australia's Threatened Reptiles* (DEWHA 2011a).

Timing of survey

The BAM survey guide for Striped Legless Lizard stipulates survey between September and December and that artificial cover boards should be in place 3 months (or 12 weeks) prior to the first survey. Boards were installed 2 August 2023, with the first of eight weekly monitoring events taking place on 18 October 2023. Although the first monitoring event was conducted one week early (after 11 weeks), this was done to avoid unfavourable weather conditions the following week.

Survey personnel and relevant experience

Reptile surveys were undertaken by the Biosis ecologists outlined in Table 23.

Table 23 Targeted reptile survey personnel and relevant experience

Staff member	Role	Relevant experience
Bret Stewart	Senior Zoologist – Technical Lead	Over 15 years' herpetofauna survey experience
Caragh Heenan	Senior Zoologist	Over four years' experience undertaking reptile surveys in NSW and 16 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Emma Heath	Graduate Zoologist	Over one year of experience undertaking flora and fauna surveys in NSW.
Mitchell Palmer	Principal Ecologist	Over 14 years' flora and fauna survey experience
Joel Nicholson	Zoologist	Over four years' herpetofauna survey experience

Results

Table 24 provides a summary of the results of the reptile surveys completed.

Table 24 Summary of reptile survey method and results

Species name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Delma impar</i> Striped Legless Lizard*	18 October 2023-29-November 2023. Artificial shelter site installation and monitoring.	Detected at eight of 10 tile grids (32 incidences). Not detected during habitat survey.	Recorded 32 times during artificial shelter monitoring. Species polygon covers 173.5 ha.

* - A recent study has determined that Striped Legless Lizard occurring within the Hunter Valley are no longer a subpopulation of Striped Legless Lizard, and are a separated species, Hunter Valley Delma *Delma vescolineata*. Currently, *D. vescolineata* is not listed under the BC Act or EPBC Act, however, listing under both Acts is considered likely.

It is currently under assessment for potential threatened species listing under the EPBC Act within the Endangered category criteria, with public comment on the draft Conservation Advice having closed on 4 August 2023, and assessment due 30 April 2024. The Commonwealth, States and Territories have agreed to implement a Common Assessment Method for the assessment and listing of threatened species. That process may be implemented in NSW by the application of Section 4.14 of the BC Act. By that mechanism, if the species was to be assessed to be under a category of threat under the EPBC Act and the NSW Threatened Species Scientific Committee is satisfied with that assessment, it can accept the assessed threat status for the purposes of the BC Act.

At present, future listing of *D. vescolineata* under the BC Act and/or EPBC Act is not certain, but can be reasonably assumed. Given this, Biosis sought advice from the BCS regarding how *D. vescolineata* should be assessed with the response stating that for the purposes of the BAM, *D. vescolineata* is to be assessed as Striped Legless Lizard. Therefore, this approach has been carried forward in this BDAR.

Further information regarding *D. vescolineata* can be found in Appendix 5.



Plate 1 *Delma vescolineata* recorded within the subject land during tile monitoring in November 2023

Limitations

No limitations to the targeted reptile survey described above were encountered.

Mammals

Targeted mammal surveys were undertaken for:

- Eastern Pygmy-possum *Cercartetus nanus*
- Greater Glider *Petauroides volans*
- Squirrel Glider *Petaurus norfolcensis*
- Brush-tailed Rock-wallaby *Petrogale penicillata*
- Brush-tailed Phascogale *Phascogale tapoatafa*
- Koala *Phascolarctos cinereus*
- Grey-headed Flying-fox *Pteropus poliocephalus*

Survey method and effort

Camera trapping was undertaken for arboreal mammals and included four baited cameras per hectare up to 1 hectare then an additional two cameras per hectare of potential habitat to satisfy the requirements for Brush-tailed Phascogale. Cameras were deployed for a minimum of four weeks (28 days), with rebaiting after two weeks. Up to 194.26 hectares of suitable habitat has been identified within the subject land, of which 79.67 hectares is to be directly impacted, requiring a total of 162 camera traps under the guidelines. A total of 11 traps were deployed over 29 nights within the subject land (319 trap nights undertaken), plus additional opportunistic trapping outside of the subject land to the north (four traps providing an additional 116 trap nights).

Koala survey employed the Spot Assessment Technique (SAT) to detect Koala scats and scratches (Phillips & Callaghan 2011). SAT surveys involve two person-minutes searching per 30 Koala food trees with diameter at breast height of greater than 10 centimetres within suitable habitat, per PCT. Searches included tree trunks for scratch marks and scats within 1 metre of the base of the tree. SAT surveys were required within 250 metre grids, as the subject land is greater than 50 hectares. Up to 194.26 hectares of suitable habitat has been identified within the subject land, of which 79.67 hectares is to be directly impacted, requiring a total of 13 SAT survey points.

Spotlight surveys were conducted on two separate nights, one week apart to determine the presence of arboreal fauna within hollows located in the subject land. A total of four nights of survey were undertaken to cover suitable habitat (two nights of survey per unit of area). Effort for spotlighting was determined by Koala survey requirements, which prescribes 200 metres of transect to be surveyed per 2.5 hectares of suitable habitat at a rate of 10 metres per minute. Up to 194.26 hectares of suitable habitat has been identified within the subject land, of which 79.67 hectares is to be directly impacted, requiring a total of 32 transects, or 6.4 kilometres of survey.

Justification of survey method and effort

Survey guidelines followed include:

- *Survey Guidelines for Australia's Threatened Mammals* (DEWHA 2011b).
- *Koala (Phascolarctos cinereus) Biodiversity Assessment Method Survey Guide* (DPE 2022c).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).
- *EPBC Act Referral Guidelines for the Vulnerable Koala* (DoE 2014).
- *Koala Habitat Protection Guideline* (DPIE 2020c).
- *The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus* (Phillips & Callaghan 2011).

Timing of survey

Survey was conducted in relation to requirements in the TBDC survey guides.

Survey personnel and relevant experience

Terrestrial and arboreal mammal surveys were undertaken by the Biosis ecologists outlined in Table 25.

Table 25 Targeted mammal survey personnel and relevant experience

Staff member	Role	Relevant experience
Dr Caragh Heenan	Senior Zoologist	Over four years' experience undertaking fauna surveys in NSW and 16 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Julia Hutton	Graduate Ecologist	Over two years of experience undertaking fauna surveys in NSW.

Results

Table 26 provides a summary of the results of the mammal surveys completed.

Table 26 Summary of mammal survey method and results

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	27-30 March 2023: Spotlighting through suitable habitat for one hour, repeated on two occasions (minimum). 2-31 May 2023: Camera trapping for 14 consecutive nights.	Not recorded during surveys.	N/A
<i>Petauroides volans</i>	Greater Glider	2-31 May 2023: Camera trapping for 14 consecutive nights. 27-30 March 2023: Spotlighting through suitable habitat for one hour, repeated on two occasions (minimum).	Not recorded during surveys.	N/A
<i>Petaurus norfolcensis</i>	Squirrel Glider	2-31 May 2023: Camera trapping for 14 consecutive nights. 27-30 March 2023: Spotlighting through suitable habitat for one hour, repeated on two occasions (minimum).	Not recorded during surveys.	N/A
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	2-31 May 2023: Camera trapping. Four baited cameras per ha up to 1 ha then an additional two	Species was recorded during camera trapping surveys that were undertaken to the	76.24 ha The species was recorded. Species polygon includes wooded areas of

Species name	Common name	Survey method	Survey results	Species Polygon (ha) or count within the subject land
		cameras per ha of potential habitat. Deployed for a minimum of four weeks (28 days), with rebaiting after two weeks. 11 traps deployed over 29 nights (minimum 319 trap nights undertaken plus additional opportunistic trapping, which included four traps outside of the subject land to the north providing an additional 116 trap nights). 27-30 March 2023: Spotlighting through suitable habitat for one hour, repeated on two occasions (minimum).	north of the subject land, in areas that are not proposed to be impacted, however are connected to areas within and adjacent to the development.	PCT 3431 High, PCT 3431 Regen, PCT 3431 Low and PCT 4015 Moderate and PCT 4015 Low.
<i>Phascolarctos cinereus</i>	Koala	2-31 May 2023: Camera trapping for 14 consecutive nights. 11-12 July 2023, 7 November 2023, 13-14 November 2023: SAT surveys – Two minutes searching per 30 Koala food trees with diameter at breast height > 10 cm within suitable habitat, per PCT. Searches included tree trunks for scratch marks and scats within 1 m of the base of the tree. 27-30 March 2023: Spotlighting through suitable habitat.	Not recorded during surveys.	N/A
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	28 October 2022, 7-8 November 2022: Searches for breeding camps.	No camps recorded. Incidental foraging individuals recorded during spotlight surveys in March 2023.	N/A



Plate 2 Brush-tailed Phascogale captured on remote camera 7 in the early hours of 9 May 2023

Limitations

Guidelines dictate camera trapping be undertaken for Brush-tailed Phascogale at high densities and in the case of the subject land, 151 camera traps would be required. Due to the impracticality of deploying, collecting and rebaiting this number of cameras, a subset (11 within the disturbance footprint and four within the study area) was deployed initially. As the species was recorded, no additional survey to meet the guidelines was required. While the species was recorded outside of the current disturbance footprint, it has been assumed present for the purposes of offsetting due to the inability to survey according to the guidelines and the high likelihood the species utilises connected habitats within the disturbance footprint.

SAT surveys were undertaken within 250 metre grids, however SAT points within open paddocks did not include a full suite of 30 trees due to the scattered nature of the vegetation. In these areas, all trees within the grid were surveyed.

Microbats

Targeted microbat surveys were undertaken for:

- Large-eared Pied Bat *Chalinolobus dwyeri*
- Little Bent-winged Bat *Miniopterus australis*
- Large Bent-winged Bat *Miniopterus orianae oceanensis*
- Southern Myotis *Myotis macropus*

- Eastern Cave Bat *Vespadelus troughtoni*

Survey method and effort

Units were deployed 23 February 2023. Units were scheduled for retrieval 3 March 2023 however, due to unforeseen access restrictions some of the units were not able to be retrieved until 17 March 2023. The number of detector nights for each unit is shown in Table 27.

Table 27 Microbat survey effort

Unit number	Unit type	Date deployed	Date retrieved	Number of detector nights
660062	Anabat Express (FS)	23/2/2023	3/3/2023	2*
660063	Anabat Express (FS)	23/2/2023	17/3/2023	23
660064	Anabat Express (FS)	23/2/2023	17/3/2023	21*
600665	Anabat Express (FS)	23/2/2023	3/3/2023	8
660066	Anabat Express (FS)	23/2/2023	3/3/2023	8
669188	Anabat Swift	23/2/2023	3/3/2023	8
09098	SM4BAT	23/2/2023	3/3/2023	0*
09103	SM4BAT	23/2/2023	17/3/2023	23
TOTAL				93

* unknown equipment failure resulted in less nights recorded than expected based on retrieval date.

Calls were recorded from dusk until dawn using five Titley Scientific Anabat Express (Full Spectrum upgrade), one Titley Scientific Anabat Swift and two Wildlife Acoustics Songmeter SM4BAT ultrasonic recorders fitted with omnidirectional microphones.

Each time a bat flies past the detector, its call is recorded as a digital file (defined here as a 'pass') that is saved directly onto a memory card in the detector unit. Files were recorded in full spectrum format (.wav). Default settings for trigger, sensitivity, sampling rate and minimum / maximum frequency were used. Units were set on trigger mode to record at night from sunset until sunrise.

All units were deployed at ground level (between 1-3 metres above the ground). Representative images of detector deployments are shown below.



Plate 3 Detector placement within the site

Data was viewed using Anabat Insight (version 2.0.8, licensed), Titley Scientific.

Species identification was first refined by using known species geographic distributions (Churchill 2008, Australasian Bat Society 2022m) to generate a list of species with potential to occur at the site.

Files not containing bat calls (noise files) were filtered out using a standard “allbats” filter in Anabat Insight. These calls were not included in further analysis and no manual review of these files (labelled as ‘trash’) was undertaken.

A custom decision tree was used to sort remaining files into likely species and species groups.

Calls were identified by visually comparing the spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls and descriptions from available reference materials (Reinhold et al. 2001, Pennay, Law, & Reinhold 2004).

A call (pass) was defined as a sequence of five or more consecutive pulses of similar frequency and shape. Identification was not attempted for sequences with less than five defined consecutive pulses (unless for readily identifiable species such as the White-striped Freetail-bat *Austronomus australis*). Similarly, sequences containing multiple bats or pulses with irregular frequency and / or shape (non-search-phase calls) were not identified to species level.

The objective of call analysis was to generate a list of species present, with a focus on threatened species, rather than analyse species activity. Once a species was positively identified, it was recorded as present.

Species identification was therefore not attempted for all files recorded. Where a threatened species was not identified through results generated by the decision tree, additional checks were used to improve confidence that a false negative was not recorded including target frequency filters and manual review of 'noise' files.

Due to variability in the quality of calls and difficulty in distinguishing some species a conservative approach was taken when analysing calls and assigning an identification. The identification of each call was assigned a confidence rating (Duffy et al. 2000) as summarized in the Table 28 below. Species identification was guided by the probability of occurrence at the site based on distribution, database records obtained from NSW BioNet and known habitat values present.

Table 28 Bat call confidence ratings

Identification	Description
C – Almost certain	Call characteristics diagnostic, matching those described in reference material, including species reference calls.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or frequency, or call lacks sufficient detail (e.g. call quality) to be definite.
SG – Species Group	Call characteristics (e.g. frequency, shape) overlap with other species or call lacks sufficient detail (e.g. call quality) making it too difficult to distinguish between species.
X – Not Detected	Of the data analysed, no calls were attributable to this species.

Justification of survey method and effort

Survey was undertaken with reference to the following guidelines:

- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).
- *Survey guidelines for Australia's threatened bats* (DEWHA 2010b).

Timing of survey

Survey was conducted during December, when bat activity, including that of Southern Myotis, is likely to be high, to maximise the chance of detection of threatened species. Survey timing is compliant with that stipulated by the TBDC (October – March).

Survey personnel and relevant experience

Microbat surveys were undertaken by the Biosis ecologists outlined in Table 29.

Table 29 Targeted microbat survey personnel and relevant experience

Staff member	Role	Relevant experience
Dr Caragh Heenan	Senior Zoologist – bat detector deployment	Over four years' experience undertaking bird surveys in NSW and 16 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Felicity Williams	Senior Zoologist – data analysis and reporting	Over 12 years' experience in bat call data analysis.

Results

Bat activity was relatively high, averaging 250 passes per night. The maximum activity recorded per night was 1378 passes (660065) and the minimum was zero (660066). Bat activity appeared to vary geographically, with activity highest at 669188 (average of 662 passes per night over 8 nights) and lowest at unit 660063 (average of 9 passes per night over 23 nights). Activity appeared highest on units placed in proximity to dams, which are likely to act as focal points in the landscape for foraging and drinking.

Fifteen species were positively identified (Definite or Probable). Eight additional species may also have been recorded however reliable identification to species level was not possible due to data quality and/or similarity of call characteristics between species.

Table 30 provides a list of all species known or predicted to occur in the study area, their conservation status, and identification following call analysis.

Table 30 Bat call analysis results

Species name	Common name	BC Act status	EPBC Act status	Identification
<i>Austronomus australis</i>	White-striped Free-tailed Bat	-	-	C
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	PR
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-	C
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	-	-	C
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	C
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	C
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	C
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	C
<i>Myotis macropus</i>	Southern Myotis	V	-	SG
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	-	-	SG
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	-	-	SG
<i>Ozimops planiceps</i>	South-eastern Free-tailed Bat	-	-	C
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	-	-	C
<i>Phoniscus papuensis</i>	Golden-tipped Bat	V	-	X
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	-	-	C
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	C
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	C
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	-	-	C
<i>Scotorepens orion</i>	South-eastern Broad-nosed Bat	-	-	C
<i>Vespadelus darlingtoni</i>	Large Forest Bat	-	-	SG
<i>Vespadelus pumilus</i>	Eastern Forest Bat	-	-	SG
<i>Vespadelus regulus</i>	Southern Forest Bat	-	-	SG

Species name	Common name	BC Act status	EPBC Act status	Identification
<i>Vespadelus vulturnus</i>	Little Forest Bat	-	-	SG

Table 31 provides a summary of the threatened microbat species recorded and their respective species polygons as appropriate. It should be noted

Table 31 Summary of threatened microbat survey method and results

Species name	Common name	Survey method	Survey result	Species polygon (ha) within subject land
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	PR	NA – no foreseeable roost habitat features inside or within 2 km of the subject land.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	C	NA - Not required for ecosystem credit species
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	C	NA - Not required for ecosystem credit species
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	C	NA - Not required as no breeding habitat within subject land
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	C	NA - Not required as no breeding habitat within subject land
<i>Myotis macropus</i>	Southern Myotis	V	SG	153.54
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	C	NA - Not required for ecosystem credit species
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	C	NA - Not required for ecosystem credit species

Limitations

Ultrasonic sampling is associated with a number of limitations. Detectability of bats relates to the intensity of their calls, their flight characteristics and the structure of the surrounding vegetation, all of which influence the distance over which a bat can be detected. Differences in the probability of detection may result in reduced likelihood of recording and therefore positively identifying some species as present within a site.

Manual call analysis is also associated with limitations including the sometimes arbitrary selection of useable calls and subjectivity of the observer.

It is important to note that only a small number of calls were attributed to Large-eared Pied Bat. Three probable calls were recorded on three separate units across two nights, suggesting very low activity at the site

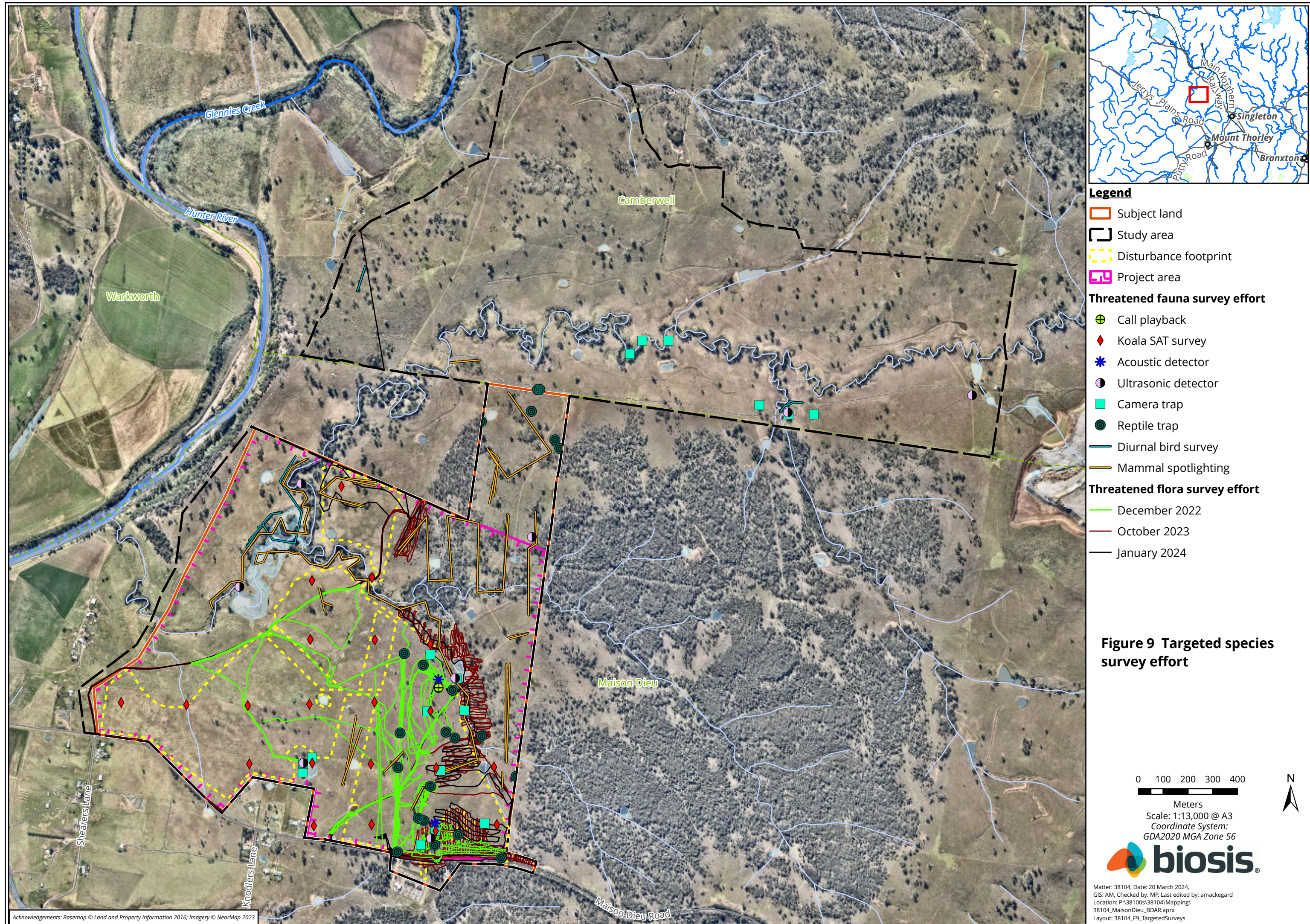
for this species. Little Bent-winged Bat was similarly recorded in small numbers. Both these species are readily identifiable from calls.

Where threatened species calls overlap with non-threatened species, call analysis has taken a conservative approach in assuming the call could represent the threatened species. This is most relevant in the case of Southern Myotis, that has a call that is notoriously difficult to separate from the more common Long-eared Bats (*Nyctophilus* species).

4.2.2 Incidental flora and fauna surveys

The following threatened species were recorded during incidental surveys undertaken as part of the current assessment:

- Grey-crowned Babbler (Vulnerable, BC Act) on eight occasions throughout October and November 2022 and January 2023.
- Grey-headed Fly-fox (Vulnerable, BC Act and EPBC Act) observed foraging on two occasions in March 2023.
- Speckled Warbler *Chthonicola sagittata* (Vulnerable, BC Act).



4.2.3 Local data

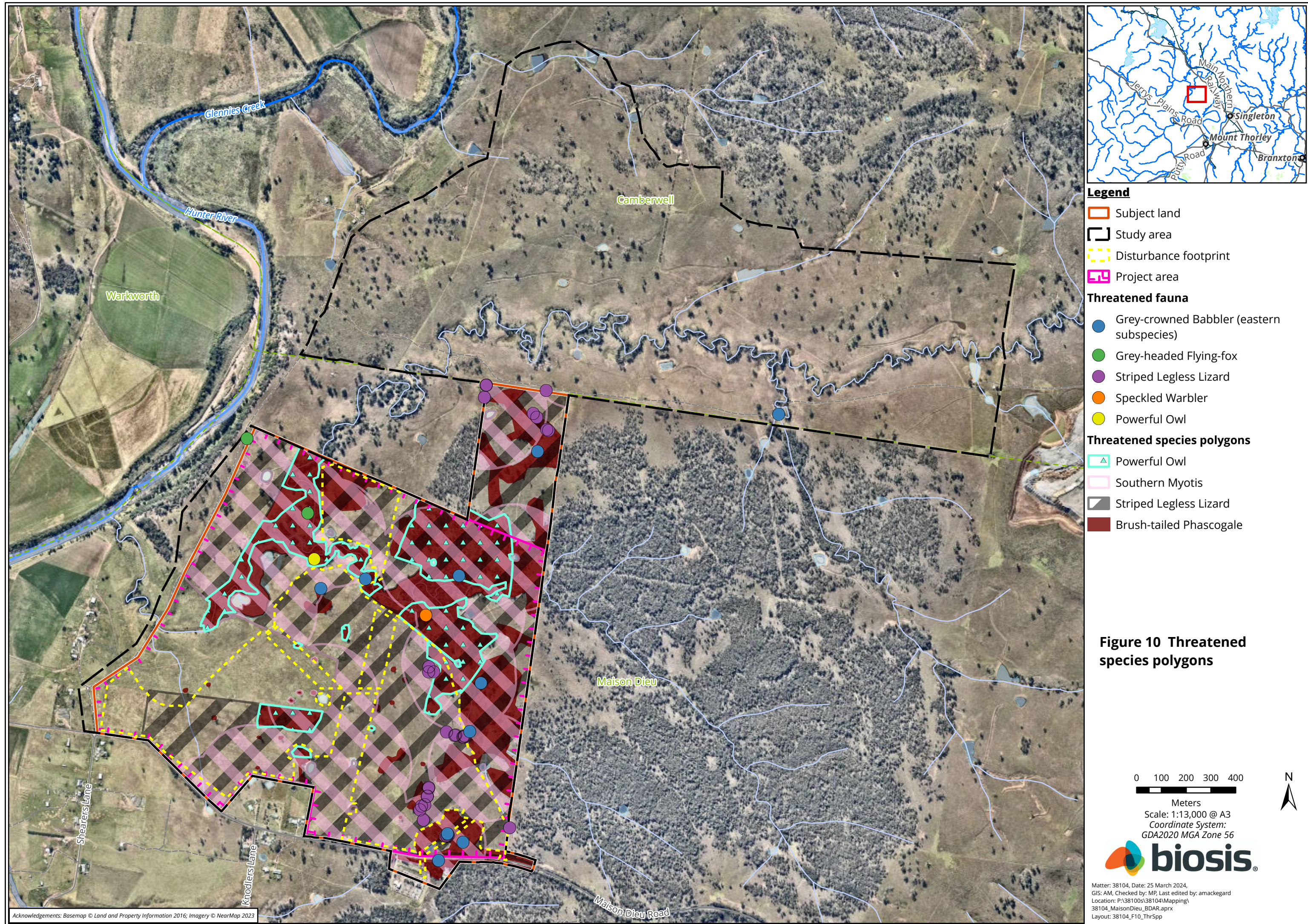
No local data was used in the preparation of this BDAR.

4.2.4 Threatened species summary and polygons

Table 32 provides details of threatened species impacted by the Project and outlines the attributes that comprise the threatened species polygons. The presence of threatened species impacted by the Project is illustrated in Figure 10.

Table 32 Threatened species polygons within the disturbance footprint

Threatened species	Subject land (ha / No. indiv.)	Impact (ha / No. indiv.)	Unit of measure	Biodiversity risk weighting	Polygon attributes
Flora					
None	-	-	-	-	-
Fauna					
<i>Delma impar</i> Striped Legless Lizard	173.49	75.74	Area	1.50	The species polygon for this species was informed by the vegetation zones that the species was recorded in. That is all of PCT 3431 though some areas may contain marginal habitat only due to high canopy cover.
<i>Myotis macropus</i> Southern Myotis	150.62	50.83	Area	2.00	All associated PCTs (PCTs 3431 and 4015) within 200 m of potential foraging habitat (waterbodies with pools/stretches 3 m wide or greater).
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	74.74	10.89	Area	2.00	Predominantly habits continually wooded vegetation, however, paddock trees are noted as important habitat in the TBDC for this species. As such, all wooded areas within PCTs 3431 and 4015 have been included in the species polygon.
<i>Ninox strenua</i> Powerful Owl	32.94	4.02	Area		A species polygon was drawn to include all vegetation zones within 800 m of the estimated location containing a living or dead tree with a hollow >20 cm diameter that occurs >4 m above the ground.



STAGE 2 — IMPACT ASSESSMENT (BIODIVERSITY VALUES)

5 Avoid and minimise impacts

This section demonstrates the efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the Project location in accordance with BAM, including an analysis of alternatives:

- Modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology.
- Routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route.
- Alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location.
- Alternative sites within a property on which the project is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site.
- Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through project design.
- Identification of any other site constraints that the applicant has considered in determining the location and design of the project.

5.1 Actions to avoid/minimise project impacts

The principal means to reduce impacts on biodiversity values within the development site is to avoid and/or minimise the removal of native vegetation and fauna habitat.

Biosis' engagement to prepare this BDAR commenced in late October 2022, at which time initial site assessments, including vegetation and habitat mapping were undertaken across the following months. Initially, as represented by the study area in Figure 1, a significantly larger area than the subject land was investigated for its potential to site the Project (EMM Consulting 2022). The results of ongoing field investigation through late 2022 and early 2023 were used to determine the locations of highest biodiversity value (such as TECs and high density hollow-bearing trees) and areas more suited to development (Figure 11). This resulted in the areas earmarked for development during initial design planning in December 2022 being iteratively refined and reduced to avoid and minimise impacts to areas of highest biodiversity values within the proposed footprint with the final substantial revision coming in August 2023, whereby the disturbance footprint was reduced by approximately 89 hectares from the April 2023 iteration. Most importantly when considering impacts to biodiversity, was the avoidance of close to all PCT 3431_High and the vast majority of 3431_Regen. These vegetation zones are not only the highest condition areas of PCT 3431 and its associated BC Act and EPBC Act listed TECs, but also the areas of highest quality habitat for Brushed-tailed Phascogale, Grey-headed Flying Fox and the threatened microbats detected. Only one dam, which is foraging habitat for Southern Myotis, would be impacted. Impacts to habitat for Striped Legless Lizard is intrinsically more difficult to avoid as the grassland habitat that this species prefers aligns with the areas most suited to development. Nevertheless, the disturbance footprint in derived grassland has been reduced as much as possible (to 19.5% of the total habitat within the study area) and avoidance of the northern areas of the subject land, as well as impacts to Striped Legless Lizard that will be ameliorated through the application of a suite of mitigation and compensatory measures (Section 7) in addition to the retirement of species credits.

Table 33 details the spatial reduction in impacts to biodiversity values throughout the design process. Figure 13 shows the investigation area from the scoping report (EMM Consulting 2022) for the Project and a design iteration from April 2023 which was refined to the final disturbance footprint assessed in this BDAR.

Table 33 details the hollow-bearing trees recorded within the study area and whether removal or retention is proposed for each tree. Of the 132 hollow-bearing trees recorded within the study area, 20 (or 15%) are proposed to be removed. Given that hollow-bearing trees were not exhaustively surveyed within the study area, the actual proportion of tree removed is likely to be significantly less.

Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered in Table 35.

Table 33 Reduction of impacts to biodiversity values through design iteration

Biodiversity value	Study area (ha)	April 2023 disturbance footprint (ha)	Subject land (ha)	Final disturbance footprint (ha)
PCT 3431 High, Regen and Low condition classes (BC Act EEC)	120.17	17.56	56.26	10.79
PCT 3431 High and Regen classes (EPBC Act CEEC)	94.06	8.54	44.39	1.83
Foraging and general habitat for Grey-headed Flying-fox, Brush-tailed Phascogale, Powerful Owl and threatened microbats	145.74	18.74	66.23	10.89
Striped Legless Lizard habitat (all PCT 3431)	406.13	194.45	175.92	75.74
Dams that provide foraging habitat for Southern Myotis	21	9	15	1
Hollow-bearing trees	132	31	74	20

Table 34 Summary of hollow-bearing tree removed and retained by the Project

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
1	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm					Retained
2	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
3	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
4	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
5	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
6	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
7	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
8	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
9	Stag	Medium Tree 20-50cm			Yes		Retained
10	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Retained
11	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
12	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
13	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
14	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes	Yes		Retained
15	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
16	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
17	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
18	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Retained
19	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
20	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	<Null>		Yes			Retained
21	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
22	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
23	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Very Large Tree > 100cm		Yes			Retained
24	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
25	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
26	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
27	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
28	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
29	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
30	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained
31	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
32	Stag	Medium Tree 20-50cm			Yes		Retained
33	Stag	Medium Tree 20-50cm			Yes		Retained
34	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
35	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
36	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
37	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
38	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
39	Stag	Medium Tree 20-50cm			Yes		Retained
40	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
41	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
42	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
43	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
44	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm				Yes	Retained
45	Stag	Medium Tree 20-50cm			Yes		Retained
46	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
47	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
48	Stag	Medium Tree 20-50cm	Yes		Yes		Retained
49	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
50	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
51	Stag	Large Tree 50-100cm			Yes		Retained
52	Stag	Medium Tree 20-50cm		Yes			Retained

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
53	Stag	Large Tree 50-100cm			Yes		Retained
54	Stag	Large Tree 50-100cm			Yes		Retained
55	Stag	Large Tree 50-100cm	Yes		Yes		Retained
56	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
57	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
58	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
59	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
60	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
61	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
62	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
63	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
64	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
65	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
66	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
67	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
68	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes	Yes			Retained
69	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained
70	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained
71	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
72	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
73	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes	Yes		Retained
74	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
75	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
76	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
77	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes	Yes		Removed
78	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Removed

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
79	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
80	Grey Box <i>Eucalyptus moluccana</i>	Large Tree 50-100cm			Yes		Removed
81	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained
82	Stag	Large Tree 50-100cm			Yes		Retained
83	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
84	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Retained
85	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
86	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
87	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained
88	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Retained
89	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
90	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
91	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
92	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
93	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
94	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
95	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
96	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
97	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
98	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
99	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Retained
100	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
101	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
102	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
103	Stag	Large Tree 50-100cm			Yes		Retained
104	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained

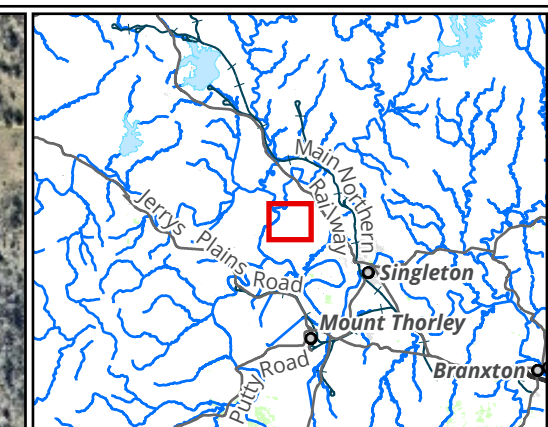
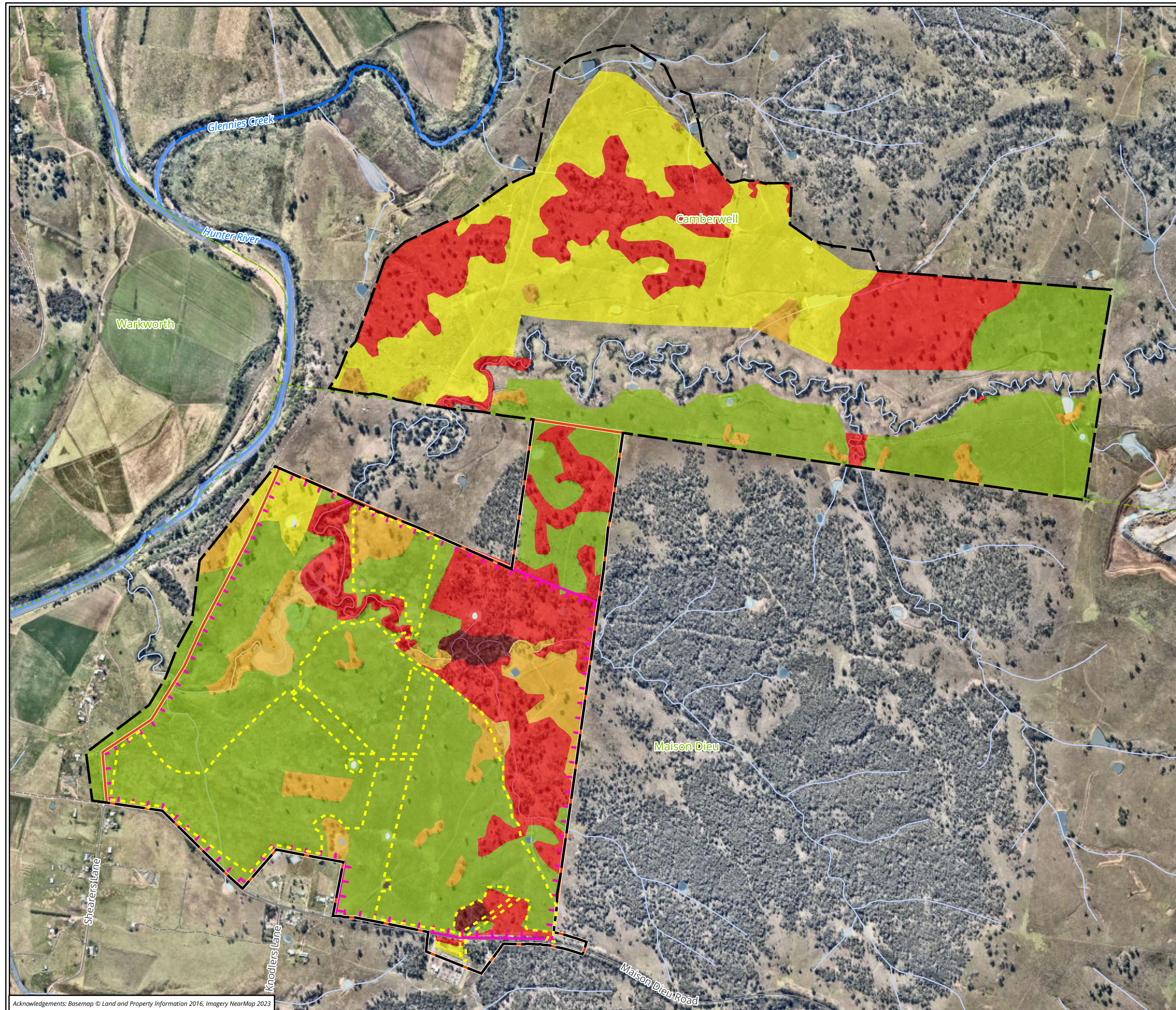
Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
105	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
106	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Retained
107	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
108	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
109	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
110	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
111	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
112	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
113	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
114	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
115	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
116	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
117	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
118	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
119	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
120	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
121	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
122	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Removed
123	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
124	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
125	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
126	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Retained
127	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
128	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
129	Eucalyptus spp.	Large Tree 50-100cm		Yes			Retained
130	Eucalyptus spp.	Large Tree 50-100cm	Yes	Yes			Retained

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
131	Eucalyptus spp.	Very Large Tree > 100cm		Yes			Retained
132	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm		Yes			Retained

Table 35 Avoidance and minimisation of impact

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
<i>Modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology.</i>	Investigate modes or technologies that would avoid or minimise impacts on biodiversity values.	Given the nature of the Project, no modes of technologies are available that would assist to avoid or minimise impacts to biodiversity. The connection to the neighbouring substation section is likely to be above ground, however, complete disturbance to the connection corridor has been assessed.	Project design	Project Proponent
<i>Routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route.</i>	Investigate routes that would avoid or minimise impacts on biodiversity values.	Given the nature of the Project, there are limited opportunities to select routes to avoid or minimise impacts on biodiversity values. All internal access tracks are utilising cleared areas as much as practicable. The grid connection easement takes the shortest possible route and has been situated to avoid an area of high condition native vegetation.	Project design	Project Proponent
<i>Alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location</i>	Investigate alternate locations that would avoid or minimise impacts on biodiversity values	Ultimately, the Project location was chosen as it is: - low, relatively flat terrain for cost-effective construction; - located away from towns and urbanised areas; - in proximity to the regional centre of Singleton, and other Hunter Valley locations, which should allow for optimal sourcing of	Project conception	Project Proponent

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
		labour from the local community; - suitable land use zoning; - good access to existing electricity infrastructure, transmission and distribution network; - good access to a major road (New England Highway and the Golden Highway); and high level of available capacity on the grid transmission and distribution system.		
<i>Alternative sites within a property on which the project is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site.</i>	Locating the Project within the available lot boundaries.	The positioning of the Project has been designed to take advantage of existing cleared areas, non-native vegetation or lower condition native vegetation. Areas of native vegetation in higher condition (3431_High, 3431_Regen and 4015_Moderate) have largely been avoided.	Project design	Project Proponent
<i>Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through project design.</i>	Utilizing project design to avoid areas of highest biodiversity value.	As previously described in this section, identification of areas of highest biodiversity values has allowed for avoidance of these areas through design iteration.	Project design	Project Proponent
<i>Identification of any other site constraints that the applicant has considered in determining the location and design of the project.</i>	Identification of any other site constraints such as bushfire and flood planning.	Such constraints were identified and considered in the Project design. This includes allowance for clearing for asset protection zones.	Project design	Project Proponent



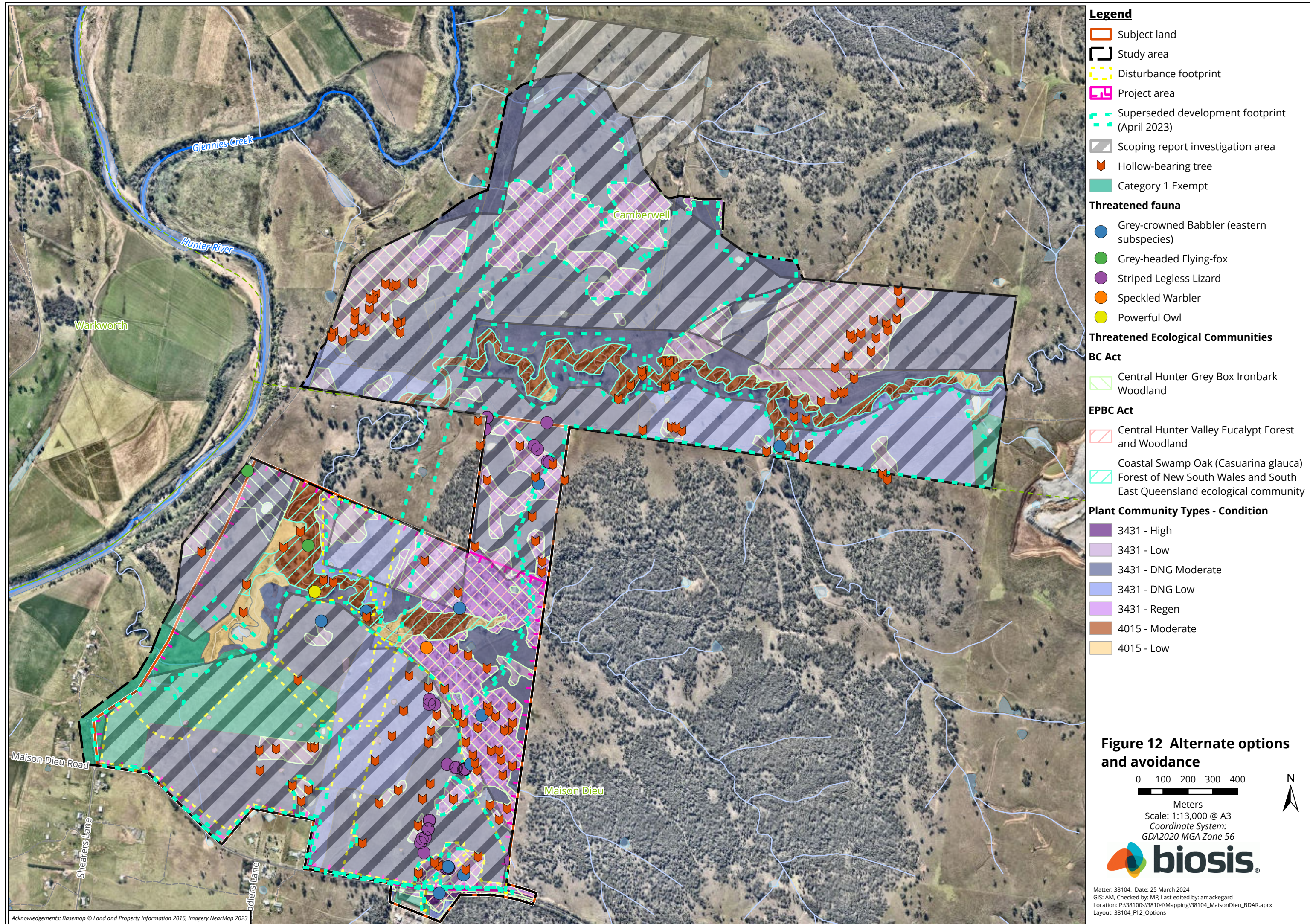
- Legend**
- Subject land
 - Study area
 - Disturbance footprint
 - Project area
- Initial constraints mapping**
- Very High
 - High
 - Moderate
 - Low-Moderate
 - Low

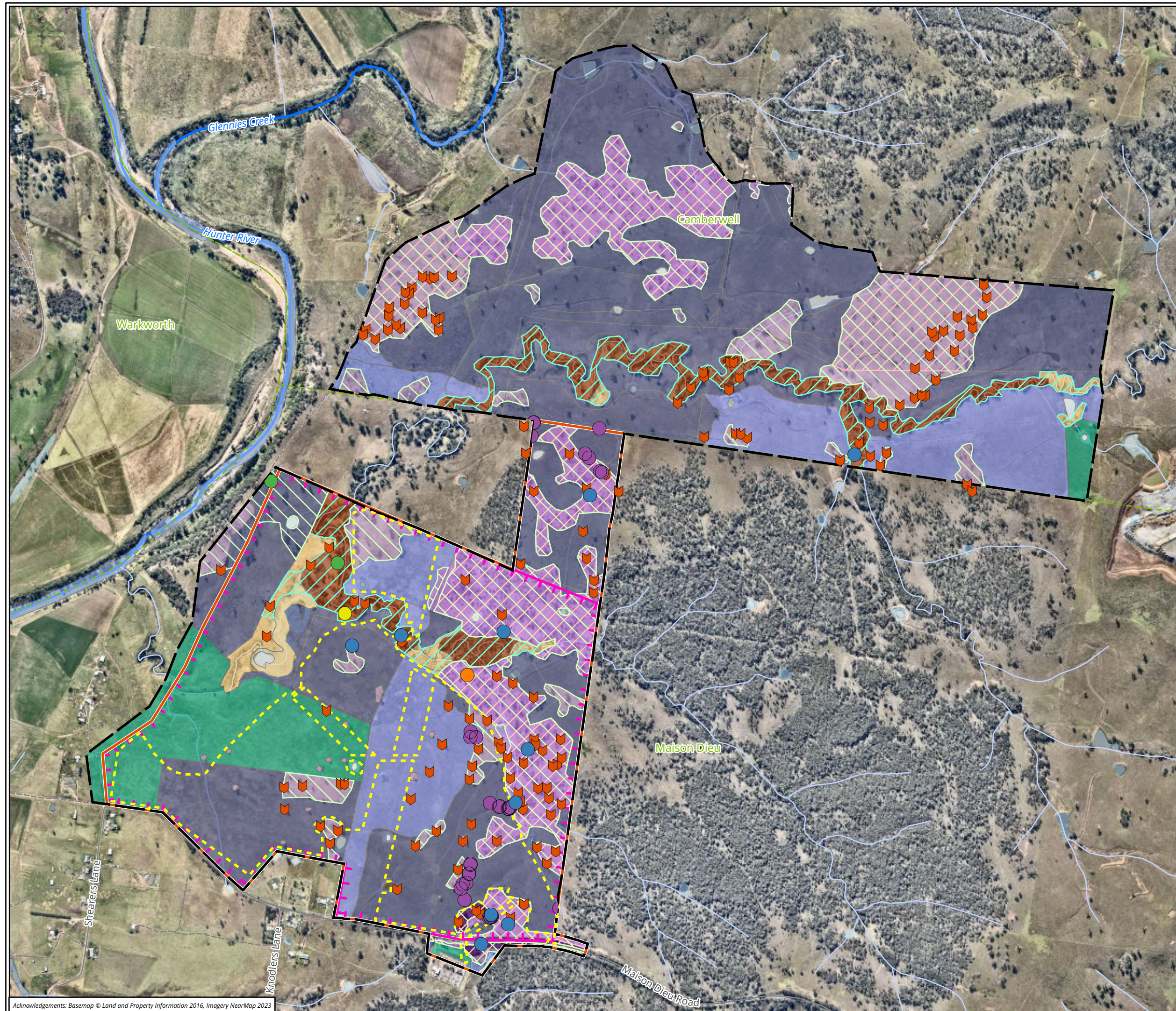
Figure 11 Initial constraints mapping

0 100 200 300 400
Meters
Scale: 1:13,000 @ A3
Coordinate System:
GDA2020 MGA Zone 56



Matter: 38104, Date: 20 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F11_Constraints





Legend

- Subject land
- Study area
- Disturbance footprint
- Project area
- Hollow-bearing tree
- Category 1 Exempt

Threatened fauna

- Grey-crowned Babbler (eastern subspecies)
- Grey-headed Flying-fox
- Striped Legless Lizard
- Speckled Warbler
- Powerful Owl

Threatened Ecological Communities

BC Act

- Central Hunter Grey Box Ironbark Woodland

EPBC Act

- Central Hunter Valley Eucalypt Forest and Woodland
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Plant Community Types - Condition

- 3431 - High
- 3431 - Low
- 3431 - DNG Moderate
- 3431 - DNG Low
- 3431 - Regen
- 4015 - Moderate
- 4015 - Low

Figure 13 Final development footprint

0 100 200 300 400

Meters

Scale: 1:13,000 @ A3

Coordinate System:

GDA2020 MGA Zone 56



Matter: 38104, Date: 25 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F13_DevFootprint

6 Impacts that are unable to be avoided

Assessment of direct and indirect impacts unable to be avoided has been undertaken in accordance with the BAM (DPIE 2020a). The following direct and indirect impacts are unable to be avoided in progressing the proposed development.

6.1 Direct impacts

Direct impacts arising from the Project include (Figure 13):

- Removal of 75.84 ha of native vegetation comprising the following PCTs and TECs:
 - 75.74 ha of PCT 3431, 10.79 ha of which is considered Central Hunter Grey Box Ironbark Woodland (Endangered, BC Act), and 1.83 ha considered Central Hunter Eucalypt Forest and Woodland (Critically Endangered, EPBC Act).
 - 0.10 ha of PCT 4015 which is considered Coastal Swamp Oak Forest (Endangered, EPBC Act).
- Removal of 10.89 ha of Brush-tailed Phascogale habitat.
- Removal of 75.74 ha of Striped Legless Lizard habitat.
- Removal of 50.83 ha of habitat for Southern Myotis.
- Removal of 10.89 ha of habitat for four ecosystem credit species microbats:
 - Eastern Coastal Free-tailed Bat
 - Eastern False Pipistrelle
 - Greater Broad-nosed Bat
 - Yellow-bellied Sheath-tail-bat
- Removal of 10.89 ha of foraging habitat for several species credit species microbats:
 - Eastern Cave Bat
 - Large Bent-winged Bat
 - Large-eared Pied Bat
 - Little Bent-winged Bat
- Removal of 4.02 ha of native vegetation within the Powerful Owl species polygon and four trees that meet the habitat constraint for Powerful Owl - a living or dead tree with a hollow >20 cm diameter that occurs >4 metres above the ground. It should be noted that all four trees are either isolated paddock trees (three trees) or part of a small patch. This does not preclude them from use by Powerful Owl, as suggested by the TBDC, but in consideration of the relatively undisturbed and higher quality habitat that occurs within and contiguous with the subject land to the east, they are less likely to be utilised by a breeding pair.
- Removal of 10.89 ha of Grey-crowned Babbler and Speckled Warbler (ecosystem credit species) habitat.
- Removal of 10.89 ha of Grey-headed Flying-fox foraging habitat.

These impacts will occur progressively from the commencement of construction of the development. Mitigation measures outlined in Section 5.1 above will help to minimise the potential impacts to biodiversity values that remain present within the subject land.

A summary of PCTs/zones directly impacted is demonstrated in Table 36. Impacts to species credit species habitat polygons are detailed in Table 37.

Table 36 Summary of direct impacts to vegetation

Zone	PCT_Condition	TEC	Area within subject land (ha)	Area within disturbance footprint (ha)	VI Score
1	3431_DNG_Low	-	30.10	19.12	6.6
2	3431_DNG_Moderate	-	85.56	45.83	28.5
3	3431_High	- Central Hunter Grey Box Ironbark Woodland (Endangered, BC Act) - Central Hunter Eucalypt Forest and Woodland (Critically Endangered, EPBC Act)	2.14	0.07	63.9
4	3431_Regen	- Central Hunter Grey Box Ironbark Woodland (Endangered, BC Act) - Central Hunter Eucalypt Forest and Woodland (Critically Endangered, EPBC Act)	42.25	1.76	49.2
5	3431_Low	Central Hunter Grey Box Ironbark Woodland (in part) (Endangered, BC Act)	11.87	8.96	26.5
6	4015_Moderate	Coastal Swamp Oak Forest (Endangered, EPBC Act)	9.97	0.10	62.2
7	4015_Low	-	8.38	0	100

Table 37 Summary of direct impacts species credit habitat or individuals

Species	Sensitivity to gain class	Area (ha)
<i>Delma impar</i> Striped Legless Lizard (Vulnerable, BC Act and EPBC Act)	High	75.74
<i>Myotis macropus</i> Southern Myotis (Vulnerable, BC Act)	High	50.83
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale (Vulnerable, BC Act)	High	10.89
<i>Ninox strenua</i> Powerful Owl (Vulnerable, BC Act)	High	4.02

6.1.1 Loss of hollow bearing trees

The Project would result in the loss of up to 20 hollow-bearing trees as shown in Table 38.

Table 38 Summary of hollow-bearing tree removed by the Project

Tree ID	Species name	DBH category (cm)	Small	Medium	Large	Extra Large	Proposed impact
77	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes	Yes		Removed
78	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Large Tree 50-100cm			Yes		Removed
79	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
80	Grey Box <i>Eucalyptus moluccana</i>	Large Tree 50-100cm			Yes		Removed
107	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
108	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
111	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
113	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
114	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
115	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
116	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
117	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
118	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
119	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm		Yes			Removed
120	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
121	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
122	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm	Yes		Yes		Removed
123	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
127	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed
128	Narrow-leaved Ironbark <i>Eucalyptus crebra</i>	Medium Tree 20-50cm			Yes		Removed

6.2 Prescribed impacts

Identification and assessment of prescribed biodiversity impacts are outlined and addressed in Table 39, and the section below, and shown in Figure 15.

Table 39 Identification of prescribed impacts

Prescribed impact	Description of relevant habitat features associated with prescribed impacts	Threatened species likely to utilise habitat features associated with prescribed impact	Severity of impact
Karst, caves, crevices, cliffs, rocks and other geological features of significance	The subject land does not contain any karst, caves, crevices, cliffs, or other geological features of significance. The subject land does contain a localised area in the south-west where a small amount of embedded rock is present. However, this area has been avoided by the disturbance footprint, therefore this prescribed impact is not discussed further.	N/A	N/A
Occurrences of human-made structures and non-native vegetation	The subject land does not contain any human-made structures of note other than transmission line towers that would not be impacted. The Category 1 land mapped in the west of the subject land contains a high degree of non-native grass cover.	Striped Legless Lizard is known to prefer open grassland habitat, an assertion supported by the finding of the targeted survey undertaken for this BDAR. However, the areas of exotic grassland are not considered viable habitat for Striped Legless Lizard. Not due to the lack of native species, but due to the lack of structural diversity. Currently these areas are grazed to the extent that ground vegetation is unlikely to provide adequate cover for Striped Legless Lizard. Given this prescribed impact is not considered likely to impact threatened entities, this prescribed impact is not considered further.	Low
Corridors or other areas of connectivity linking habitat for threatened entities	The subject site does not form part of a recognised corridor, but it is situated on the west edge of a considerable patch of connected native vegetation. Furthermore, there is some diffuse (stepping stone) connectivity through the subject land linking this large patch of vegetation with that lining the Hunter River to the east.	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats	Connectivity of habitats is an ecological function important for the sustenance of ecological communities, flora and fauna and the Project has been designed in such a way to take advantage of cleared or sparsely vegetated areas to have minimal impact. This means that any connective function the subject land may serve for the mobile species listed would remain. In the case of Striped Legless Lizard, populations are most likely sedentary and not reliant on connective

Prescribed impact	Description of relevant habitat features associated with prescribed impacts	Threatened species likely to utilise habitat features associated with prescribed impact	Severity of impact
		- Grey-crowned Babbler - Speckled Warbler - Grey-headed Flying-fox	features for viability. Nevertheless, the population, or populations, present within the subject land will remain connected to habitat to the north, west and south of the subject land.
Water bodies or any hydrological processes that sustain threatened entities	The subject land contains a number of natural waterways and artificial waterbodies (dams). The current hydrological processes, coupled with other abiotic factors, have resulted in the present ecology of the subject land. Given a significant change in land use, the Project is likely to alter the processes. The Project also has the potential to impact surface water flow and quality by: - Introducing sediment-laden runoff. - Transporting pollutants. - Leaks and spills mixing with run-off. - Exposing contaminated soils to rainfall and runoff. - Obstructing water flows by temporary access tracks and earthworks during construction.	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats - Grey-crowned Babbler - Speckled Warbler - Grey-headed Flying-fox	The dams within the subject land represent foraging habitat for Southern Myotis, of which, one would be filled. Given the availability of similar habitat within the subject land and assessment area, a single dam is unlikely to be important to the persistence of the local population of the species. A Water Impact assessment prepared for the Project found that the Project should not result in any significant adverse impacts to surface water or groundwater in the Project Area or local vicinity. Impacts can be appropriately controlled via management and mitigation measures proposed. In light of the above, the Project is considered unlikely to alter hydrological process that currently sustain the threatened entities present within the subject land.
Protected animals that may use a proposed wind farm development site as a flyway or migration route	This prescribed impact is not relevant to the Project.	N/A	N/A
Where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community	The Project is certain to result in increased vehicle traffic during the construction phase of the Project and to a far less extent, the operational phase of the Project. This increased vehicle traffic has the potential to impact upon native fauna species that are active during the day, and generally with a	- Construction hours are limited to the day or early evening time, so possible vehicle strike of nocturnal fauna, including microbats and Brush-tailed Phascogale) is not anticipated. - Commonly occurring fauna, including birds and macropods.	Non-threatened, ground dwelling fauna known to inhabit the general area, particularly macropods such as Swamp Wallaby <i>Wallabia bicolor</i> and Eastern Grey Kangaroo <i>Macropus giganteus</i> , are notoriously prone to vehicle strike. Vehicle strike of macropods is likely to

Prescribed impact	Description of relevant habitat features associated with prescribed impacts	Threatened species likely to utilise habitat features associated with prescribed impact	Severity of impact
	higher potential for impact in areas where refuge/forage habitat exists immediately adjacent to areas where vehicle movements will occur, primarily Maison Dieu Road.		be an impact already in place, which may be exacerbated during construction.

6.2.1 Habitat connectivity

Nature

The subject land does not form part of a recognised wildlife corridor, but it is located on the periphery of significant connective feature situated between the New England Highway in the north to the Hunter river in the south, a distance of around 7.5 kilometres. Additionally, the subject land serves as a link to habitats along the Hunter River to the west.

Extent

The solar farm and BESS, upon construction, would be entirely fenced and pose an impediment to movement for less mobile-ground dwelling fauna. However, such species could still move through the Project east to west via a vegetated creek line, and around the Project to the north and south.

The Project is not considered likely to interrupt habitat connectivity for mobile fauna such as birds, microbats and arboreal mammals. Though some woody vegetation would be removed, this is either as single trees or small patches on the forest edge such that no area of consistent canopy would be severed and introduce a barrier to movement. Vegetated creeklines within the subject land would not be fenced off and as such their existing function as conduits would not be altered.

Perimeter fencing along the east and west of the subject land will run parallel to the existing tree line maintaining connectivity in a north-south direction.

Development of solar arrays would reduce areas of occupancy and connectivity of areas to retained habitat for Striped Legless Lizard. Although the species has limited dispersal capability (up to 60 metres), movement through array areas may be reduced as the nature of the underlying groundcover would be altered and may no longer suit passage of the species. Mitigation in the form of highly adaptive management plans to ensure long viability of the species is discussed in Section 7.

Duration

Impact to connectivity of wooded area would be one-off and permanent. After decommissioning of the Project, connectivity of habitat for ground dwelling species is likely to be restored.

Consequences for entities detailed in Table 39

The Project would increase the current level fragmentation within the subject land and assessment area by introducing further cleared areas. However, for species that utilise trees, this is the removal of 'stepping stone' type connectivity rather than significantly vegetated connectivity features. As discussed above, no barrier to the movement of ground dwelling fauna would be introduced.

The Project is considered unlikely to be of any discernible consequence to any of the noted threatened entities as free passage of individuals and propagules would still be possible.

Post construction, it is unclear to what degree the anticipated natural recolonisation of areas between solar arrays would restore the present level of connective habitat. Plausibly, Striped Legless Lizard would still be able to pass through solar array areas or reside, provide the structure of grasses remains, however, as the species has low dispersal abilities and low population spread (<12 m per year), this would require future monitoring over an extended period of time. The requirements for maintenance of the height of grass cover

under solar arrays and between solar arrays prior to and during peak risk periods for insurance purposes and bushfire risk, will likely affect structural diversity of grass cover in the long term, and effect the viability of these areas to provide optimal habitat for the *Delma*. Conversely, the presence of the solar arrays may provide artificial habitat but this remains uncertain at this time without ongoing monitoring over a least a five year period. An adaptive biodiversity management plan will be implemented with detailed measures included to minimise impacts to *Delma* during construction and upon operation.

6.2.2 Water bodies, water quality and hydrological processes

Nature

The subject land contains many artificial waterbodies (dams) and two main waterways. Current water quality and hydrological process (how water flows and is distributed across the subject land) contribute to the sustenance of the vegetation present, and in turn, the threatened entities that rely on said vegetation.

Extent

One dam, in the north-west of the disturbance footprint would be directly impacted (filled in). No other dams would be directly impacted.

Many actions have the potential to impact water quality during construction of the Project. Various mitigation measures and safeguards (Section 7), in accordance with relevant guidelines and accepted industry practice, would be in place to manage the risk of impacts to water quality and the receiving environment. This would include arrangements for managing pollution risks associated with spillage or contamination on the site and adjoining areas. Surface water quality monitoring programs are recommended to be included in both the CEMP and Operational Environmental Management Plan (OEMP).

To mitigate the potential surface water quality impacts of the Project during operation, the Project would have its own surface water drainage / quality treatment system with appropriate controls to mitigate any potentially adverse impacts. Water passage is not likely to change as a result of construction activities if existing drainage paths are not blocked or redirected. Construction activities would be managed to minimise the potential for drainage infrastructure to become blocked or obstructed.

Design and construction of the Project would seek to maintain existing catchment and flow patterns as much as practicable, such that an impactful difference between current and post construction difference is not anticipated.

Duration

Removal of one waterbody, in the north-west of the subject land, would be one-off and permanent. Hydrological changes are likely to be most pronounced during construction, with little difference anticipated for the life of the Project.

Consequences for entities detailed in Table 39

The removal of one dam and to a very small reduction in local foraging habitat for Southern Myotis, is unlikely to have a discernible impact on the persistence of the local population.

With mitigation and management measures in place, there would be a low risk of water quality impacts on surface water receptors during construction and operation of the Project. Similarly, an impactful change in

current hydrological processes is not anticipated long-term, inferring there would be a negligible impact to those threatened entities listed in Table 39.

6.2.3 Vehicle strikes

Nature

The Project has the potential to result in increased vehicle strikes during construction due to increased vehicle movements and, in particular, heavy vehicles during construction.

Extent

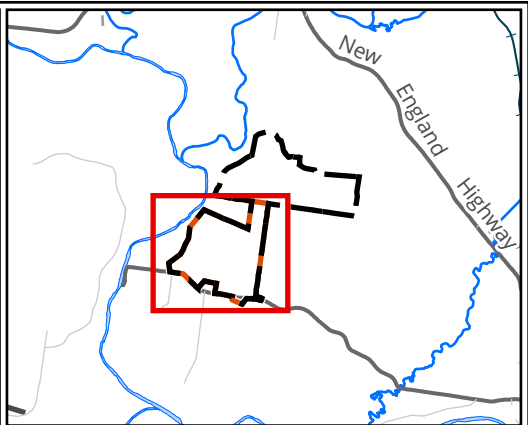
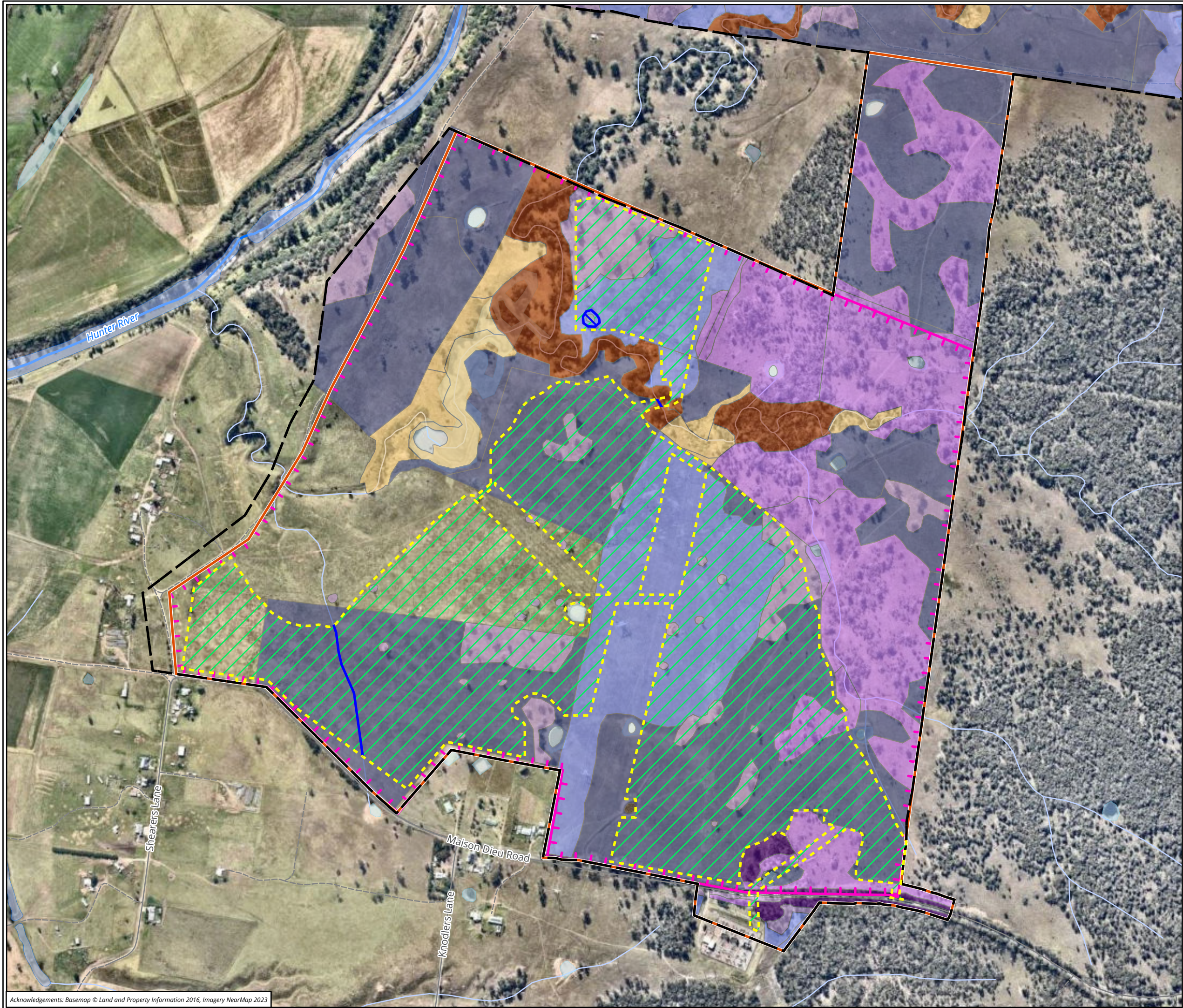
Increased heavy vehicle movements would occur during construction; however, no increase is anticipated during operation of the Project. Increase in vehicle movements would occur on vegetation edges as far as practicable rather than through patches of retained habitat.

Duration

The potential for increased vehicle strikes would occur during construction of the Project. This impact is not considered to increase above present levels for the operational life of the Project.

Consequences for entities detailed in Table 39

It can be reasonably expected that the potential for vehicle strikes can be effectively managed through driver awareness training on the potential for fauna to occur, as well as on-site measures such as reduced speed limits and signage. As such, the Project is not expected to result in any substantial or significant impacts associated with vehicle strikes.



- Legend**
- Subject land
 - Study area
 - Disturbance footprint
 - Project area
- Plant Community Types - Condition**
- 3431 - High
 - 3431 - Low
 - 3431 - DNG Moderate
 - 3431 - DNG Low
 - 3431 - Regen
 - 4015 - Moderate
 - 4015 - Low
- Prescribed impacts**
- Hydrology (hydro areas)
 - Hydrology (waterways)
 - Habitat connectivity

Figure 14 Prescribed impacts

0 100 200

Meters

Scale: 1:8,000 @ A3

Coordinate System:
GDA2020 MGA Zone 56

N

biosis

Matter: 38104, Date: 25 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F14_PrescribedImpacts

6.3 Indirect impacts

This section details potential indirect impacts associated with the construction and operation of the Project following the implementation of proposed avoidance and minimisation measures. Indirect impacts are considered to potentially occur in areas outside the disturbance footprint, but within the subject land (Figure 15). In accordance with the BAM, an applicant can retire credits to offset indirect impacts that cannot be avoided or adequately minimised. In this instance, indirect impacts can be adequately mitigated within a Biodiversity Management Plan via active and adaptive management, and improve and maintain principles.

Potential indirect impacts arising from the Project are outlined and addressed in Table 40. Area calculations utilised a 30 metre buffer of the disturbance footprint.

Table 40 Assessment of indirect impacts

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
Inadvertent impacts on adjacent habitat or vegetation	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones	Up to 30.56 ha of adjacent native vegetation	One-off	Long-term	Construction and operation	Impacts to adjacent vegetation during construction and operational phase can be prevented or minimised through appropriate exclusion fencing, implementation of a Construction Environmental Management Plan (CEMP) detailing environmental protection measures, water quality practices and stormwater controls, and by ensuring any lighting is directed towards the developed area, rather than towards the adjacent retained habitats.
Reduced viability of adjacent habitat due to edge effects	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only)	Up to 30.56 ha of adjacent native vegetation	Unknown	Indefinite for noise and light spill, short-term for dust	Construction and operation	The potential for the Project to significantly or substantially increase edge effects to adjacent vegetation and habitats is considered relatively low. Vegetation present within and adjacent to the disturbance footprint is largely already subject to moderate to high levels of edge effects given the adjoining large areas of cleared farmland. Efforts have been made to minimise and avoid impact to vegetation in higher ecological condition and parts of large, connected areas.

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	- Grey-crowned Babbler - Speckled Warbler					
Reduced viability of adjacent habitat due to noise, dust or light spill	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler	Up to 30.56 ha of adjacent native vegetation	Unknown	Indefinite for noise and light spill, short-term for dust	Construction and operation	It is predicted that the adjacent habitat may be impacted by noise, dust and light spill, during construction, however less likely during the operation of the Project. During construction, this would be managed via practices outlined in a CEMP. Increased light spill during operation can affect microbat activity. Effects vary from positive, such as an increase in prey items (insects) to negative whereby bats may not fly through overly lit areas rendering any adjacent habitat no longer viable. Although there is uncertainty, given the threatened microbat species recorded are often detected in urbanised areas, it is reasonable to assume that they are in some way resilient to light pollution, and any impacts are not likely to be substantive.
Transport of weeds and pathogens from the site to adjacent vegetation	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis	Up to 30.56 ha of adjacent native vegetation	Unknown	Possibly long-term	Construction and operation	Weeds occurring within the disturbance footprint are common with those occurring within adjacent vegetation to be retained. Increased transport of pathogens and weeds is unlikely to occur, however would be managed by biosecurity measures outlined in the CEMP. Furthermore, an Agricultural Biosecurity

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	- Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler					Management Plan would also be developed.
Increased risk of starvation, exposure and loss of shade or shelter	- Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler	Up to 30.56 ha of adjacent native vegetation	One-off	Long-term	Construction	The removal of 75.84 ha of native vegetation and one farm dam (Southern Myotis foraging habitat) proposed would constitute a loss of foraging resources; however, this is not considered likely to increase the risk of starvation for these species when the broad extent of available habitat within the assessment area is taken into account. The Project would also remove sheltering resources for hollow-dependent microbats (20 trees). While the removal of sheltering vegetation is a small proportion of the commensurate habitats available within the assessment area, the removal of potential roost/sheltering sites is a more adverse impact, but not one that is likely to result in mortality of individuals.
Loss of breeding habitats	- Brush-tailed Phascogale - Powerful Owl - Eastern False Pipistrelle - Eastern Coastal Free-tailed Bat	20 hollow-bearing trees - Up to 30.56 ha of adjacent	One-off	Long-term	Construction	Twenty hollow-bearing trees would be removed by the Project. Threatened species that may use these hollows based on surveyed results include the listed hollow-dependent microbats, Powerful Owl and Brush-tailed Phascogale.

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	- Yellow-bellied Sheath-tail-bat - Greater Broad-nosed Bat - Southern Myotis - Striped Legless Lizard	native vegetation				Indirect impacts associated with the loss of breeding habitats are not considered likely to be substantial or significant to any locally occurring threatened, or non-threatened, microbat species. Up to 75.74 ha of habitat for Striped Legless Lizard habitat would be removed and it is highly likely a portion of this is used for breeding.
Trampling of threatened flora species	-	-	-	-	-	No threatened flora species were found, or are considered likely to occur, within the subject land, and thus trampling of threatened flora species is unlikely.
Inhibition of nitrogen fixation and increased soil salinity	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones	Nil	NA	NA	NA	It is not considered likely that the future development of the subject land would result in substantial changes to the level of nitrogen fixation or soil salinity within the subject land.

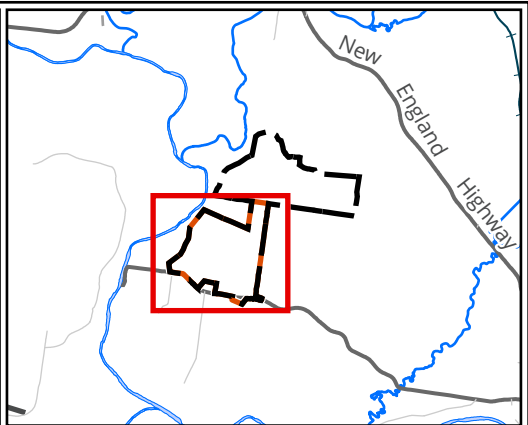
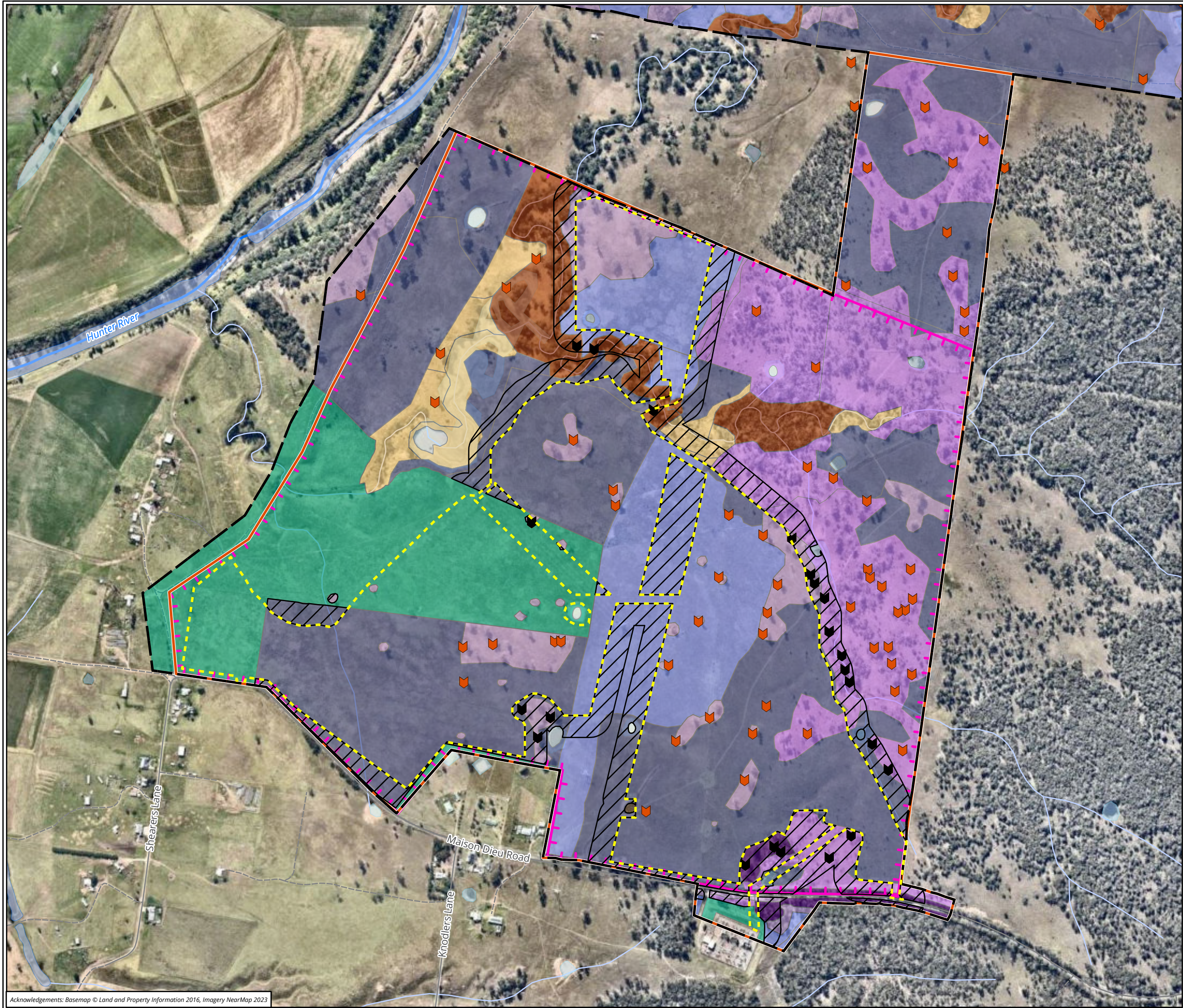
Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
Fertiliser drift	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones	Nil	NA	NA	NA	The Project does not include the use of fertilisers. If anything, use of the subject land as a solar farm and battery storage facility may reduce fertiliser in the local context.
Rubbish dumping	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler	Nil	NA	NA	NA	Potential for this indirect impact to occur is considered negligible. Appropriate measure for the management of construction related rubbish would be detailed in the CEMP.

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	• Speckled Warbler • Non-threatened vegetation zones					
Wood collection	• Central Hunter Grey Box Ironbark Woodland • Central Hunter Eucalypt Forest and Woodland • Coastal Swamp Oak Forest • Striped Legless Lizard • Brush-tailed Phascogale • Southern Myotis • Powerful Owl • Ecosystem credit microbats • Species credit microbats (foraging only) • Grey-crowned Babbler • Speckled Warbler • Non-threatened vegetation zones	Nil	NA	NA	NA	The Project is unlikely to increase access to retained vegetation, beyond current access capacity. Unauthorised access and collection of wood is expected to be a negligible risk.
Removal and disturbance of rocks, including bush rock	• Striped Legless Lizard	Minimal	One-off	Long-term	Construction	The subject land contains minimal exposed rock and no appreciable areas of 'bush rock' or rocky outcropping. Some small areas with rock sized up to around 50 cm diameter is present in the south-east of the subject land, the bulk of which has been avoided but is habitat for Striped Legless Lizard. The rock removal proposed is not seen as an additional indirect impact to the

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
						general habitat removal proposed for Striped Legless Lizard.
Increase in predators	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones	Nil	NA	NA	NA	Potential for this indirect impact to occur is considered negligible as there is no foreseeable vector to increase predators within the subject land.
Increase in pest animal populations	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats	Nil	NA	NA	NA	Potential for this indirect impact to occur is considered negligible as there is no foreseeable vector to increase pest animal populations within the subject land.

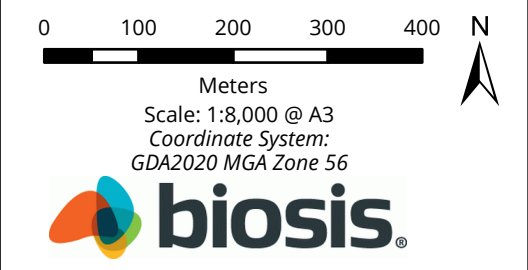
Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	- Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones					
Changed fire regimes	- Central Hunter Grey Box Ironbark Woodland - Central Hunter Eucalypt Forest and Woodland - Coastal Swamp Oak Forest - Striped Legless Lizard - Brush-tailed Phascogale - Southern Myotis - Powerful Owl - Ecosystem credit microbats - Species credit microbats (foraging only) - Grey-crowned Babbler - Speckled Warbler - Non-threatened vegetation zones	Nil	NA	NA	NA	Potential for this indirect impact to occur is considered negligible, and the requirements for legislated bushfire hazard reduction and asset protection would be implemented during construction and operation of the Project.
Disturbance to specialist breeding and foraging habitat, e.g. Beach nesting for shorebirds	Nil	Nil	NA	NA	NA	The subject land is not within any Important Habitat mapping.

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
Fragmentation of movement corridors	• Striped Legless Lizard • Brush-tailed Phascogale • Southern Myotis • Powerful Owl • Ecosystem credit microbats • Species credit microbats (foraging only) • Grey-crowned Babbler • Speckled Warbler	Negligible	One-off	Long-term	Construction and operation	While the subject land sits on the western border of a prominent connective feature within the assessment area and broader locality, the Project has been designed in such a way that very little woody vegetation would be removed. This means that any connective function the subject land may serve for the mobile species listed would remain. In the case of Striped Legless Lizard, populations are most likely sedentary and not reliant on connective features for viability. Nevertheless, the population, or populations, present within the subject land will remain connected to north, west and south of the subject land.



- Legend**
- Subject land
 - Study area
 - Disturbance footprint
 - Project area
 - Hollow-bearing tree
 - Category 1 Exempt
- Indirect impacts**
- Hollow-bearing tree
 - Vegetation
- Plant Community Types - Condition**
- 3431 - High
 - 3431 - Low
 - 3431 - DNG Moderate
 - 3431 - DNG Low
 - 3431 - Regen
 - 4015 - Moderate
 - 4015 - Low

Figure 15 Estimated zones of indirect impact for the proposal



Matter: 38104, Date: 20 March 2024
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\38104_MaisonDieu_BDAR.aprx
Layout: 38104_F15_IndirectImpacts

6.4 Impacts to Groundwater Dependent Ecosystems (GDEs)

The Bureau of Meteorology's Ground Water Dependent Ecosystems (GDEs) Atlas (Bureau of Meteorology 2024) indicates that the PCTs within the subject land are likely to have some degree of groundwater dependence. The Water Impact Assessment (WIA) prepared for the Project (Northrop Consulting Engineers 2023) found that no significant impacts to groundwater are expected during the construction or operational phases of the Project. Infrastructure areas and roads are shallow, temporary and not anticipated to reach the depth of groundwater. There would also be negligible change to surface water runoff patterns for construction, with construction being a short term timeframe. Further, no groundwater is proposed to be used to meet construction water demands. During operation, the impervious surface in the infrastructure compound is a small percentage of the Project Area which would not have significant impact on stormwater infiltration. The solar array layout will allow rainfall to continue to infiltrate into the ground surface below the elevated panels. No groundwater use is proposed to meet operational water demands.

In light of the above, the Project is considered to have negligible impact to groundwater dependent ecosystems.

6.5 Impacts considered uncertain

Impacts considered uncertain are generally those that cannot be quantified using GIS software and are difficult to predict. This includes many of the indirect and prescribed impacts discussed in Sections 6.2 and 6.2 above, such as:

- Inadvertent impacts to native vegetation adjacent the disturbance footprint.
- Introduction of pests, pathogens and weeds to native vegetation adjacent the disturbance footprint and further afield.
- Degradation of downstream habitats via worsening of water quality or alteration to hydrological processes.
- Vehicle strikes.

Impacts considered uncertain are generally managed to negligible or satisfactory levels through the application of measures and controls detailed within a CEMP and its sub-plans. Monitoring, adaptive management (Section 7) and adequate response are the key components that would be in place to successfully mitigate potential uncertain impacts to biodiversity.

At this stage of the assessment, a total loss of groundcover has been assumed to occur as a direct impact within the disturbance footprint, including areas of temporary shading and in between solar panel row alignments as well as APZs. This is considered a conservative measure as groundcover and a reduced level of biodiversity value is known to persist in currently operating solar farms in NSW, and within which grassland communities will persist in the future, and in fact, may improve. It is possible that a direct impact may not result in complete loss of biodiversity value. However, with required management between arrays and APZs for bushfire and insurance purposes, the level of value that remains post construction is highly uncertain and difficult to quantify, but estimated at a best case to be down to approximately an 80% loss of biodiversity value compared to that prior to construction and under current land use regimes.

A process for scoring of partial loss must be ecologically valid and representative, and must consider the resulting outcome and condition of vegetation over time. It is difficult to demonstrate in terms of the viability and modification of the original PCT condition post construction and during operation due to maintenance factors such as keeping ground cover heights at minimum heights for insurance purposes to address grass fire-related hazards. However, a reduction in grazing pressure and slight changes in moisture levels due to collection of dew on panels, may create an increase in abundance of grasses and forbs.

It is not proposed that applying or observing a partial loss to the solar array will be subject to detailed monitoring of proposed vegetation integrity or amelioration. Instead, a focus on improving and maintaining areas retained within the subject land is preferred to increase biodiversity value in those areas, and more broadly, as part of enhancing biodiversity measures where possible. However, if applying a partial loss incentivises further diligence and maintaining a level of biodiversity value during construction primarily, as well as during operation, then this should be considered and recognised in a reduced residual credit liability. If however this is not achievable or endorsed by the regulator, incurring a 100% loss and offsetting the full amount, will discourage retention of any biodiversity values associated with native ground cover during construction and operation.

6.6 Cumulative impacts

It is important to recognise that the Central and Upper Hunter Valley regions have historically been highly cleared and modified. This has primarily included mining of coal, other minerals, as well as primary production and farming. As of 2021, it is estimated that there were 17 active coal mines within the Singleton region. With this in mind, any future development, regardless of its nature, would contribute to this historical clearing.

An assessment of proposed or current similar renewable projects, plus those that have a more recent assessment and approval within similar PCTs, habitats and sited in the Hunter-Central Coast REZ has been carried out. This provides a summary of potential cumulative impacts to biodiversity (Table 41). Six large scale renewable energy related projects been considered.

Impacts resulting from the Project are largely consistent with impacts that are considered to occur at other nearby proposals, particularly those occurring within 50km or less. Perhaps one exception to this is the potential for the Project to impact upon Striped Legless Lizard. Impact to this species by way of area of habitat (75.74 hectares) is significantly higher than the Mount Pleasant Optimisation Project (SSD-10418) which has the next highest impact (27.4 hectares) to this species. Despite the possibility that the species could coexist with a solar farm, this is a relative unknown and would require a detailed monitoring plan to determine. Therefore, the Project is considered to have the highest proportion of the cumulative impact to Striped Legless Lizard from the projects below.

The summary of biodiversity impacts from publicly available information was reviewed to gain an understanding of the main biodiversity impacts and how these may contribute to cumulative impacts when considering the development of the project.

Table 41 Cumulative impact summary

Project, description and location	Distance	Overview	Potential biodiversity impacts
Bridgman Solar Farm (EIS Stage)	10 km east	Development of a 50 MW solar farm and associated infrastructure	Unknown, however the development footprint is 100 ha and would impact derived grasslands that may be commensurate with that within the subject land.
Bowmans Creek Wind Farm (Determination)	40 km north	Construction and operation of a wind farm with up to 60 wind turbines and associated infrastructure.	Approximately 35 ha of impact to PCTs and TECs commensurate to those within the subject land. Approximately 32 ha of impact (habitat removal) for Brush-tailed Phascogale
Muswellbrook Solar Farm (Response to submissions)	40 km north	Development of a 135 MW solar farm and associated infrastructure, including battery storage facility	Approximately 196.6 ha of impact to PCTs and TECs commensurate to those within the subject land. Approximately 19.8 ha of impact (habitat removal) for Brush-tailed Phascogale Approximately 0.42 ha of impact (habitat removal) for Southern Myotis.

Project, description and location	Distance	Overview	Potential biodiversity impacts
Muswellbrook BESS (Determination)	50 km north	Development of a 150 MW / 300 MWh battery energy storage facility with associated infrastructure	<1 ha of impact to native vegetation including habitat for Striped Legless Lizard (assumed present)
Upper Hunter BESS (EIS stage)	50 km north	Battery Energy Storage System (BESS) with a capacity of 400MW/ 800MWh and associated infrastructure	No anticipated impacts to native vegetation
Mount Pleasant Optimisation Project (Determination)	50 km north-west	Extend the life of the open cut operation by mining deeper coal seams, using existing and proposed new infrastructure	Approximately 236.9 ha of impact to PCTs and TECs commensurate to those within the subject land. Approximately 27.4 ha of impact (habitat removal) for Striped Legless Lizard
Liverpool Range Wind Farm (Assessment - Modification)	200 km north-west	Wind farm containing 185 turbines and associated infrastructure	1650.5 ha of native vegetation impact, but none commensurate with that of the subject land

7 Mitigation and management of impacts

Residual impacts occur once all efforts have been made to avoid and minimise impacts through the design phase of the project. Mitigation of unavoidable impacts is the next step in the impact reduction hierarchy and includes commitments made by the proponent to further minimise impacts to biodiversity.

Identification of measures to mitigate or manage impacts has been undertaken in accordance with the BAM (DPIE 2020a), including considerations such as:

- Techniques, timing, frequency and responsibility.
- Identification of measures for which there is risk of failure.
- Evaluation of the risk and consequence of any residual impacts.
- Documentation of any adaptive management strategy proposed.

Identification of measures for mitigating impacts related to:

- Displacement of resident fauna.
- Indirect impacts on native vegetation and habitat.
- Mitigating prescribed biodiversity impacts.
- Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain.

The Construction Environmental Management Plan (CEMP) would contain an adaptive management component. Adaptive management strategies would be receptive to new and relevant data that may arise through ongoing assessment and monitoring and are key to the successful implementation of crucial objectives, yet also allow flexibility to changing dynamics and ongoing feedback and results. This includes measures to monitor predicted and uncertain impacts which would trigger adaptive management actions and allow for effective and quick responses.

As part of the CEMP, a Biodiversity Management Plan (BMP) would be implemented demonstrating adaptive management strategies to ensure key milestones are achieved including the following project commitments:

- Protecting vegetation and fauna habitat outside the disturbance footprint and managing the remaining remnant vegetation and fauna habitat within the subject land toward a benchmark state using improve and maintain principles, minimising indirect impacts, especially to known threatened flora species and potential fauna species such as Hunter Valley Delma and Brush-tailed Phascogale.
- Fauna monitoring and management protocol including identification and reporting of fauna mortalities to the relevant BCS office.
- Collection of detailed baseline weed data and ensuring no increase of key emerging weeds or invasive pests.
- Commit to ongoing consultation about vertebrate pest control baiting programs working cooperatively with local landholders.
- Training and education awareness for all construction staff and operational staff on key threatened species, both flora and fauna, relevant to the region and project.

- Mapping and identification of active tree hollows and active stick nests within the disturbance footprint and within 50 meters of the disturbance footprint boundary to develop measures to minimise impacts to these features.
- Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained and/ or relocated.
- Monitoring of soil and water controls to prevent indirect impacts associated with water pollution to all waterways.
- Clear performance targets and monitoring criteria.
- Corrective actions.
- Timing and responsibilities.

A recommended outline of the BMP is provided below with further details demonstrated within the overview of mitigation measures provided in Table 42.

- Introduction.
- Background.
- Management scope and objectives.
- Planning requirements.
- Construction and operational activities.
- Habitat management.
- Flora and fauna values.
- Soils.
- Weeds and pests (i.e. key emerging weeds and priority weeds).
- Baseline data.
- Environmental mitigation measure.
- Site specifics.
- Inductions.
- Erosion /sediment control.
- Retained vegetation and rehabilitation works.
- Adaptive management.
- Performance criteria, triggers, and responses.
- Compliance management.
- Review and Improvement.

Table 42 Measures to mitigate and manage impacts

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
B1	Removal of native vegetation and TECs	Prescriptions for mitigation of potential impacts of construction activities on retained native vegetation and habitat will be addressed in a site-specific CEMP and BMP sub-plan. This includes - Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones. - Physically delineate vegetation to be cleared and/or protected on site and install appropriate signage prior to works commencing. - No-Go Zones should be erected during the construction phase at the extent of clearing works in patches of vegetation to ensure clearing limit is not exceeded and no vehicle or plant equipment movement occurs outside the clearing limit. These areas should be checked as part of the pre-clearing survey. - Protect trees in accordance with the requirements of Australian Standard 4970-2009 for the Protection of Trees on Development Sites. - Do not damage tree roots unless absolutely necessary, and engage a qualified arborist where roots >50mm are impacted within the Tree Protection Zone. - Retain dead tree trunks, bush rock or logs in-situ unless they are in the disturbance footprint and moving is unavoidable. Reposition material elsewhere on the site (in consultation with the landowner) or approved adjacent sites. Dead wood and Coarse Woody Debris (CWD) should be lifted and placed into adjacent vegetation, not pushed. - Undertake pre-clearance inspections by a licenced ecologist of vegetation to ensure all no-go areas are appropriately fenced. - If any threatened species (flora or fauna) is discovered during the works, stop work immediately at the site of species identification and notify the onsite Manager. Work will only recommence once	Protect retained vegetation within the subject land from adverse impacts	Pre-construction and construction.	The Proponent /contractor.

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
		the impact on the species has been assessed and appropriate control measures provided. - If any damage occurs to vegetation outside of the disturbance footprint (as shown in the CEMP), notify the onsite Manager and Environmental Representative so that appropriate remediation strategies can be developed. - A biosecurity management plan prepared as part of the project's CEMP and will prevent the spread of weeds and pathogens, and other biosecurity items into or out of the impact area upon implementation. - Secure biodiversity offsets in accordance with the NSW BOS.			
B2	Displacement of resident fauna	The BMP prepared and implemented as part of the CEMP will include: - Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas. - Pre-clearance surveys will include: <u>Fauna general:</u> - Survey of all areas to be cleared prior to construction to identify and mark all fauna habitat to be impacted including hollow-bearing trees (HBTs) - All HBTs to be removed will follow a two-stage removal process, including knocking of the tree to be removed 24 hours prior to removal. - All fauna habitat to be removed will be surveyed by a suitably qualified ecologist, prior, during and after removal. - Capture and relocation of Delma from impacted areas to adjacent habitats prior to and during early construction of solar arrays infrastructure. - Active nests will be avoided by clearing as far as practicable until fledging occurs.	Effective management of resident fauna to minimise direct impact.	Pre-construction and construction.	The Proponent /contractor.

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
		- If native fauna is likely to be present, a licenced ecologist should inspect the removal and undertake fauna relocation. <u>Flora general:</u> - All vegetation to be removed is to be clearly marked for removal. - Demarcation areas are to be erected along the clearing extent where partial clearing of a patch is to occur. Demarcation is to be retained until the completion of the construction phase. - Clearing protocols. - Procedures for unexpected threatened species finds and fauna handling.			
B3	Impacts to Striped Legless Lizard	- Measures specific to mitigating impacts to Striped Legless Lizard within the BMP include: - Minimise ground disturbance as far as practicable during installation of solar infrastructure. - Feral animal control including control of rabbits (land degradation) and foxes and cats (predation). - Prior to construction, placement of up to 3 linear tile grids (30 tiles) adjacent to solar arrays in the south east of the subject land and within the APZ, at locations which receive early morning sun, during normal operation of the solar farm. These roof tiles will augment habitat for Striped Legless Lizard, as well as allow for monitoring of the population within the disturbance area. Additional tile grids (30 tiles) will be installed at control sites within the subject land, including areas of known Striped Legless Lizard occupation (e.g. the north-east of the subject land). - Continue existing biomass reduction management regime within the fenced development via mowing/slashing. This will be carried out prior to	Minimise impacts to the viability of the Striped Legless Lizard population(s) within the subject land	Pre construction, construction and post construction	The Proponent /contractor.

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
		summer. The goal of which is to recreate the conditions of moderate grazing which are currently present. ○ Ensure that development does not cut off the retained Striped Legless Lizard habitat on site from likely habitat areas located outside the subject land. If this occurs, establish a corridor to habitat areas outside the subject land. ○ Where areas of existing occupation are fragmented by the Project, establish at least one habitat corridor with a width of 30 m within the impact area. The minimum corridor width suggested by the EPBC Act referral guidelines Section 7 (Hadden 1995) is considered adequate as the impact area either side of the corridor is not considered totally unsuitable for occupation by Striped Legless Lizard (although highly uncertain, individuals may persist in the area under solar panels, and are unlikely to be significantly obstructed or face mortality either side of the established 30 m corridor. ○ Site to be demarcated or install signage to restrict unauthorised vehicular access.			
B4	Indirect impacts on adjacent native vegetation and habitat	• Exclusion zones, including fencing, would be set up at the limit of clearing. • Where practicable, native vegetation would be re-established. • A biosecurity management plan prepared as part of the Project's CEMP/OEMP is recommended and will reduce the risk of spreading weeds and pathogens, and other biosecurity items into or out of the impact area upon implementation. • Shading and artificial light impacts would be minimised through detailed design. • All material stockpiles, vehicle parking and machinery storage, and other ancillary works are to be located within areas considered impacted within the current assessment and not be	Effective management of potential indirect impacts such that they do not occur or are minimal.	Pre-construction and construction.	The Proponent /contractor.

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
		located within retained vegetation outside the impact area unless an updated impact assessment is undertaken. - Dust suppression is to be undertaken as required using water sprays, water carts or other media on: - Unpaved work areas subject to traffic or wind. - Sand, spoil and aggregate stockpiles. - During the loading and unloading of dust generating materials. - Consider biodiversity as sensitive receivers in noise and vibration management plan. - Noise will be managed as part of the CEMP. - Lighting will be designed in general accordance with Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting.			
B5	Mitigating prescribed biodiversity impacts	Habitat connectivity - Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas. - Clearing protocols. Water bodies, water quality and hydrology - Preparation of an adaptive management plan component within CEMP and BMP outlining a cycle of 'do, monitor, evaluate and respond'. Note this is, the foundation of adaptive management widely applied to terrestrial and aquatic ecosystem management. - Prepare a CEMP and OEMP that will: - Describe measures that will be employed to minimise soil erosion and the discharge of sediment and other pollutants from the site during construction of the Project.	Effective management of prescribed impacts such that they do not occur or are minimal.	Pre-construction, construction and post-construction.	The Proponent /contractor.

	Measures to mitigate and manage impacts	Action	Outcome	Timing	Responsibility
		- Describe how water will be managed to achieve compliance with relevant consent and licence conditions. - Establish responsibilities and reporting requirements. - Establish surface water quantity and quality monitoring requirements. - Establish trigger action response plans to enable progressive improvement.			
B6	Adaptive management strategies proposed to monitor and respond to impacts on biodiversity values that are uncertain	- The CEMP would include an adaptive management component, for impacts on biodiversity that are uncertain such as: - Inadvertent impacts to native vegetation adjacent to the disturbance footprint. - Introduction of pests, pathogens and weeds to native vegetation adjacent the disturbance footprint and further afield. - Vehicle strikes.	Effective management of uncertain impacts to biodiversity by ensuring intervention can occur as needed.	Pre-construction, construction and post-construction.	The Proponent /contractor.

8 Impact summary

This section outlines the impact summary for the Project which has identified and assessed impacts on TECs and threatened species that are at risk of a Serious and Irreversible Impact (SAIL), including:

- Addressing all criteria for each TEC listed as at risk of an SAIL present on the subject land.
- Addressing all criteria for each threatened species at risk of an SAIL present on the subject land.
- Documenting assumptions made and/or limitations to information.
- Documenting all sources of data, information, references used or consulted.
- Clearly justifying why any criteria could not be addressed.
- Identification of impacts requiring offset.
- Identification of impacts not requiring offset.
- Identification of areas not requiring offset.

Figure 16 shows the location of impacts requiring offset, impacts not requiring offset and areas not requiring assessment.

8.1 Serious and irreversible impacts (SAIL)

In accordance with Clause 6.7 of the BC Regulation an impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

- Principle 1: It will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
- Principle 2: It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
- Principle 3: It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
- Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

No threatened species or communities considered to meet the above principles will be impacted by the Project. A small number of potential calls of the Large-eared Pied Bat were detected during surveys in combination with other *Chalinolobus* species calls. Due to the minimal number of low quality calls, suboptimal foraging habitat and that there is no potential optimal roost sites located within the subject land, or within 2 kilometres, no further assessment was undertaken. Suboptimal temporary habitat such as sheds, derelict concrete buildings or mining infrastructure on other private lands that were not able to be accessed or surveyed with HARP traps. As such, SAIL are not discussed further.

8.2 Identification of impacts requiring offset

8.2.1 Impacts to native vegetation (ecosystem credits)

As outlined in Section 9.2.1 of the BAM, the assessor must determine an offset for all impacts of projects on PCTs that are associated with a vegetation zone that has a vegetation integrity score of:

- ≥ 15 , where the PCT is representative of an EEC or a CEEC.
- ≥ 17 , where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community.
- ≥ 20 , where the PCT does not represent a TEC and is not associated with threatened species habitat.

On this basis, offsets are not required for vegetation zone 3431_DNG_Low as it does not have a vegetation integrity score ≥ 17 . Furthermore, no offsets are required for vegetation zone 4015_Low as it would not be directly impacted.

The offset requirement for the Project was calculated using the BAM-C. Table 43 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

Table 43 Offsets required (ecosystem credits)

Vegetation zone	Area (ha)	Impact	VI score	Offset required	TEC	Hollow-bearing trees	Credit requirement
3431_DNG_Low	19.12	Clearance	6.6	No	No	No	0
3431_DNG_Moderate	45.83	Clearance	28.5	Yes	No	No	653
3431_High	0.07	Clearance	63.9	Yes	Yes	Yes	2
3431_Regen	1.76	Clearance	49.2	Yes	Yes	Yes	43
3431_Low	8.96	Clearance	26.5	Yes	Yes	Yes	119
4015_Moderate	0.10	Clearance	62.2	Yes	Yes	Yes	3
4015_Low	0	Clearance	100	No	No	Yes	0
Total							820

8.2.2 Impacts to threatened species and their habitat

As outlined in Section 9.2.2 of the BAM an offset is also required for the impacts of Projects on threatened species that require species credits.

The offset requirement for the Project was calculated using the BAM-C. Table 44 provides a summary of the species credit offsets required for impacts from proposed development at the subject land.

Table 44 Offsets required (species credits)

Species	Vegetation zone	Habitat condition (vegetation integrity score) loss	Area (ha)	Biodiversity risk weighting	Total credit requirement
<i>Delma impar</i> Striped Lizard Legless (Vulnerable, BC Act and EPBC Act)	3431_DNG_Low 3431_DNG_Moderate 3431_High 3431_Low 3431_Regen	6.6 28.5 63.9 26.5 49.2	19.12 4583 0.07 8.96 1.76	1.50	660
<i>Myotis macropus</i> Southern Myotis (Vulnerable, BC Act)	3431_DNG_Low 3431_DNG_Moderate 3431_High 3431_Regen 3431_Low	6.6 28.5 63.9 49.2 26.5	11.74 30.48 0.05 1.71 6.85	2	608
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale (Vulnerable, BC Act)	3431_High 3431_Regen 3431_Low 4015_Moderate	63.9 49.2 26.5 62.2	0.07 1.76 8.96 0.10	2	167
<i>Ninox strenua</i> Powerful Owl (Vulnerable, BC Act)	3431_Low 4015_Moderate	26.5 62.2	3.94 0.08	2	55

Species polygons for the above species credit species impacted by the Project are illustrated in Figure 16 below.

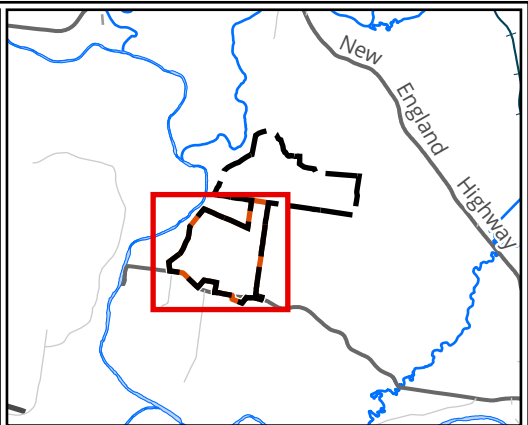
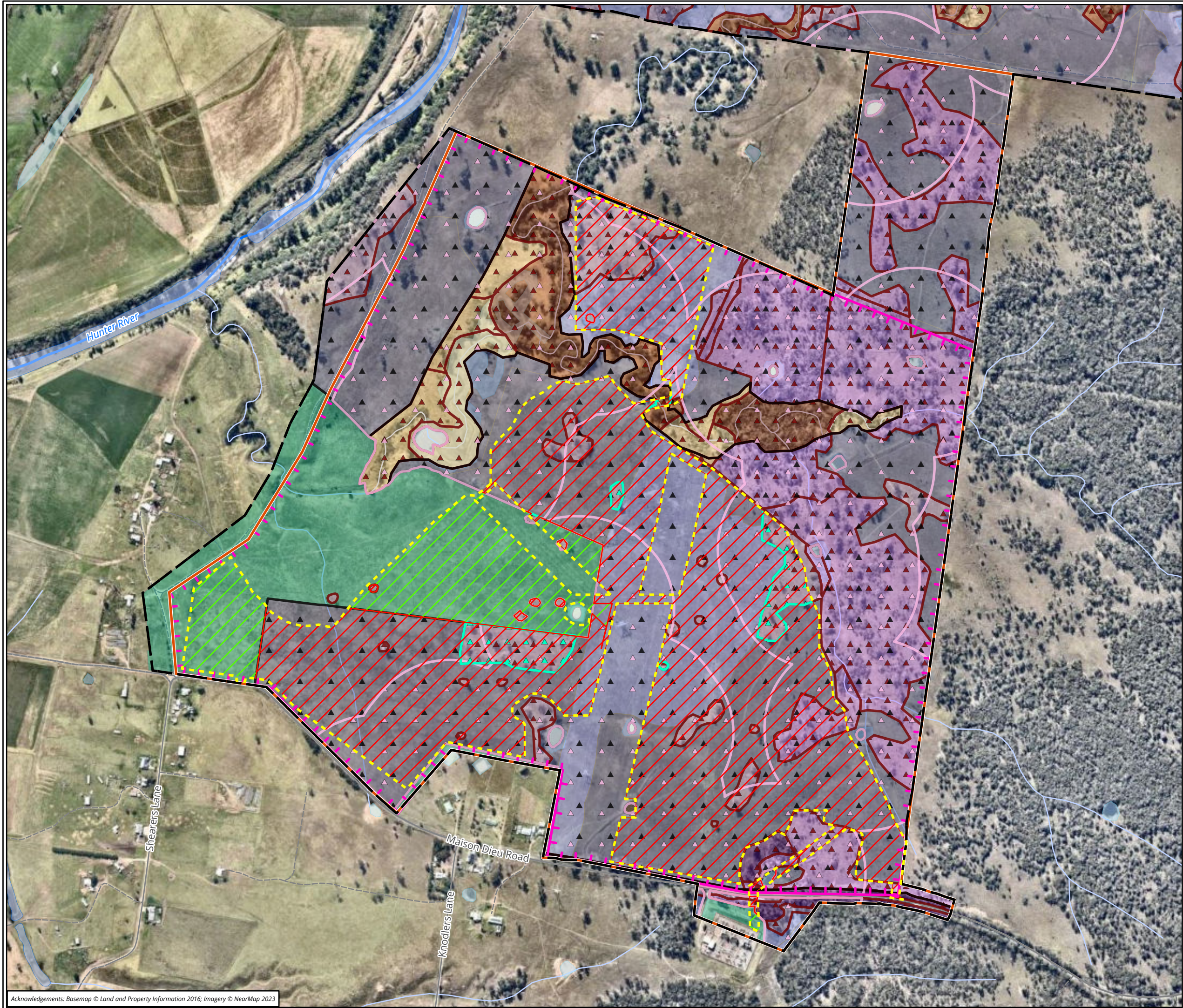
8.3 Identification of impacts not requiring offset

There are no impacts to native vegetation that are not required to be offset by either retirement of ecosystem credits and/or species credits.

Impacts to Category 1 Land do not require offsetting under the BAM.

8.4 Identification of areas not requiring assessment

There are no areas that are not required to be assessed for prescribed impacts at minimum.



Legend

- Subject land
- Study area
- Disturbance footprint
- Project area
- Category 1 Exempt

Impacts

- Impacts not requiring offsets
- Impacts requiring offsets

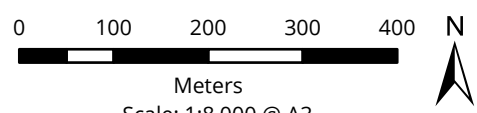
Threatened species polygons

- Powerful Owl
- Southern Myotis
- Striped Legless Lizard
- Brush-tailed Phascogale

Plant Community Types - Condition

- 3431 - High
- 3431 - Low
- 3431 - DNG Moderate
- 3431 - DNG Low
- 3431 - Regen
- 4015 - Moderate
- 4015 - Low

Figure 16 Impacts requiring offsets and impacts not requiring offset



Scale: 1:8,000 @ A3
Coordinate System:
GDA2020 MGA Zone 56



Matter: 38104, Date: 25 March 2024,
GIS: AM, Checked by: MP, Last edited by: amackegard
Location: P:\38100s\38104\Mapping\
38104_MaisonDieu_BDAR.aprx
Layout: 38104_F16_Impacts

9 Assessment against biodiversity legislation

9.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (MNES) protected under the Act. Under the EPBC Act, activities that have potential to result in significant impacts on MNES must be referred to the Commonwealth Minister for the Environment and Water to determine if it is a controlled action and if so, whether assessment and approval is required.

An EPBC Act referral was lodged on the 14 August 2023 and deemed a Controlled Action (EPBC 2023/09638) on the 31 January 2024 based on listed threatened species and communities as the relevant controlling provisions. Supplementary SEARs detailing the Cth DCCEEW's assessment requirements were provided on 12 February 2024.

An assessment of the impacts of the proposed development on MNES, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the Project to the Commonwealth Minister for the Environment and Water is required. MNES relevant to the Project are summarised in Table 45.

Table 45 Assessment of the proposed development against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	Of the threatened species recorded within the subject land, three, Large-Eared Pied Bat (Vulnerable) and Striped Legless Lizard (Vulnerable) and Grey-headed Flying-fox (Vulnerable) are listed under the EPBC Act (Vulnerable). Prior to the targeted survey program, other EPBC Act listed species, such as Koala, were thought to have a medium or higher likelihood of occurring, however survey did not detect the presence of these species. Some EPBC Act listed species, such as Spotted-tailed Quoll, are considered ecosystem credits species under the BAM and as such have not been subject to targeted survey to support this BDAR. To alleviate this limitation, the habitat assessment approach has been applied (Appendix 4). As such, only Large-eared Pied Bat, Striped Legless Lizard and Grey-headed Flying-fox are considered further.	Unlikely in the case of Large-eared Pied Bat. The individual or individual detected are not considered to be members of an important population. Furthermore, removal of habitat would be foraging only and relatively minor in the context of that present within the assessment area and broader locality. Detailed assessment is provided in Appendix 6. Possible in the case of Striped Legless Lizard due to presence of an important local population and degree of habitat removal proposed. Further detail is provided in Table 46 and Appendix 6.
Threatened ecological communities	The subject land was found to contain two EPBC Act TECs:	Unlikely, due to minor impacts (less than 1 hectare) to both TECs. Detailed

Matter of NES	Project specifics	Potential for significant impact
	- Central Hunter Eucalypt Forest and Woodland (Endangered). - Coastal Swamp Oak Forest (Endangered).	assessments are provided in Appendix 6. Further detail is provided in Table 46
Migratory species	Numerous migratory bird species may use the subject land on occasion.	Unlikely. Proposed habitat removal does not include any crucial habitat. Similar habitat is plentiful within the locality.
National Heritage Places	The subject land does not contain any National Heritage Places.	None
Wetlands of international importance (Ramsar sites)	The Ramsar listed Hunter Estuary Wetlands is located 64 km and downstream of the subject land.	Unlikely given extremely diffuse connectivity to Ramsar site. Additionally, the Project design, CEMP and OEMP would contain specific measures to ensure water quality is not impacted.

Table 46 Summary of relevant EPBC Act threatened species and ecological communities

MNES	DCCEEW consideration	Updated likelihood of occurrence based on assessment	Potential impacts	Rationale	SIC self-assessment undertaken / result (Appendix 6)
Disturbance footprint					
Central Hunter Eucalypt Forest and Woodland	Likely significant impact	Significant impact unlikely	Yes, 1.83 ha.	This community is the most dominant community within and to the west of the subject land where it covers a large expanse of land. This community has been prioritised for avoidance such that contextually a small area would be impacted.	Significant impact unlikely.
Coastal Swamp Oak Forest	Likely significant impact	Significant impact unlikely	Yes, 0.1 ha.	This community occurs along the main waterways within the subject land. Only a small impact (0.1 ha) is proposed to improve capacity and one water crossing.	Significant impact unlikely
Large-eared Pied Bat	Possible significant impact	Significant impact unlikely	Yes, 10.89 ha of foraging habitat	Large-eared Pied Bat was recorded via call detection. This species prefers caves in which to breed and roost, but may use artificial structures on occasion. No	Significant impact unlikely

MNES	DCCEEW consideration	Updated likelihood of occurrence based on assessment	Potential impacts	Rationale	SIC self-assessment undertaken / result (Appendix 6)
				such habitat is proposed to be impacted. Foraging habitat, however, is proposed to be removed.	
Striped Legless Lizard	Likely significant impact	Possible significant impact	Yes, 75.74 ha.	Striped Legless Lizard has been found to inhabit the subject land, primarily within derived native grasslands. A significant amount of habitat would be impacted and severance of connectivity may result. Mitigation measures are proposed to minimise impacts to Striped Legless Lizard during construction and operation. Residual impacts will be offset in accordance with the Biodiversity Offset Scheme and in accordance with the bilateral agreement.	Significant impact likely

9.2 Environmental Planning and Assessment Act 1979

An assessment of the Project against the relevant sections of the EP&A Act is provided below.

9.2.1 State Environmental Planning Policies

State Environmental Planning Policy (Biodiversity and Conservation) 2021

Chapter 3: Koala habitat protection 2020

This chapter applies to land zoned RU1, RU2 or RU3 in the Singleton LGA.

However, as the Project is classified as an SSD, this chapter does not apply.

State Environmental Planning Policy (Resilience and Hazards) 2021

Chapter 2: Coastal management

The aim of this chapter is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objectives of the repealed *Coastal Management Act 2016*. No

parts of the disturbance footprint occur within areas mapped under this chapter of the SEPP; therefore, it does not apply to the Project.

9.3 Biodiversity Conservation Act 2016

The NSW BC Act requires that the BAM be applied to all Projects that trigger the BOS, and that a BDAR is required to be submitted to the approval authority.

This Project is considered an SDD and, therefore, the BOS applies in accordance with Section 7.9 of the BC Act. A BDAR is required to be prepared in accordance with the BAM (DPIE 2020a).

9.4 Biosecurity Act 2015

The Biosecurity Act provides for the identification, classification and control of priority weeds with the purpose of determining if a biosecurity risk is likely to occur. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes the introduction, presence, spread or increase of a pest into or within NSW or any part of the State. A pest plant has the potential to; harm or reduce biodiversity or out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

The General Biosecurity Duty as outlined in the Biosecurity Act states:

All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Eight priority weeds for the Hunter LLS Region have been recorded in the subject land and are listed in Table 47, along with their associated Duty.

Table 47 Priority weeds within the subject land

Scientific name	Common name	Relevant biosecurity duty
<i>Eragrostis curvula</i>	African Love Grass	Regional Recommended Measure <i>Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Galenia pubescens</i>	Galenia	Regional Recommended Measure An exclusion zone is established for all land in the region, except the core infestation which includes parts of: Lake Macquarie Local Government Area, Maitland Local Government Area, Muswellbrook Local Government Area, Newcastle Local Government Area, Singleton Local Government Area, Upper Hunter Local Government Area. <i>Entire Hunter Local Land Services region: Land managers should mitigate the risk of the plant being introduced to their land. Exclusion zone: Notify local control authority if found. Land managers should</i>

Scientific name	Common name	Relevant biosecurity duty
		<i>eradicate the plant from the land and keep the land free of the plant. A person should not deal with the plant, where dealings include but are not limited to buying, selling, growing, moving, carrying or releasing the plant. Core infestation: Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Hyparrhenia hirta</i>	Coolatai	Regional Recommended Measure <i>Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value</i>
<i>Lycium ferocissimum</i>	African Boxthorn	Prohibition on certain dealings Must not be imported into the state, sold, bartered, exchanged or offered for sale. Regional Recommended Measure An exclusion zone is established for all land in the region, except the core infestation which includes parts of: Muswellbrook Local Government Area, Upper Hunter Local Government Area. <i>Entire Hunter Local Land Services region: Land managers should mitigate the risk of the plant being introduced to their land. Exclusion zone: Notify local control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. A person should not deal with the plant, where dealings include but are not limited to buying, selling, growing, moving, carrying or releasing the plant. Core infestation: Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African olive	Regional Recommended Measure An exclusion zone is established for all land in the region, except the core infestation which includes parts of: Dungog Local Government Area, Lake Macquarie Local Government Area Maitland Local Government Area, Mid Coast Local Government Area, Port Stephens Local Government Area, Singleton Local Government Area. <i>Entire Hunter Local Land Services region: Land managers should mitigate the risk of the plant being introduced to their land. Exclusion zone: Notify local</i>

Scientific name	Common name	Relevant biosecurity duty
		<i>control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. A person should not deal with the plant, where dealings include but are not limited to buying, selling, growing, moving, carrying or releasing the plant. Core infestation: Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Opuntia aurantiaca</i>	Tiger Pear	Prohibition on certain dealings <i>Must not be imported into the state, sold, bartered, exchanged or offered for sale.</i> Regional Recommended Measure <i>Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Opuntia stricta</i>	Common Prickly Pear	Prohibition on certain dealings <i>Must not be imported into the state, sold, bartered, exchanged or offered for sale.</i> Regional Recommended Measure <i>Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.</i>
<i>Senecio madagascariensis</i>	Fireweed	Prohibition on certain dealings <i>Must not be imported into the state, sold, bartered, exchanged or offered for sale.</i>

9.5 Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through an Assessment of Significance process.

There is Key Fish Habitat (KFH) as mapped within the subject land as well as the Hunter River (DPI 2023). The waterways where KFH is mapped are classified as a combination of third and fourth order streams (Strahler 1964), under the *Water Management Act 2000* (WM Act). NSW DPI is required to assess all Projects that involve structures that span the full width of a waterway (including pipe crossings) or modifies the velocity or quantity of water. As a one creek crossing is proposed, a precautionary approach would involve applying for a permit

under Part 7 of the FM Act to temporarily obstruct fish passage during construction (Section 219), and for dredging or reclamation works (Section 201).

The Hunter River and Glennies Creek to the north are mapped as potential habitat for the FM Act listed Southern Purple Spotted Gudgeon (DPI 2023) (Figure 2). No linkage between the waterways within the subject land and Glennies Creek is discernible, thus the Project is not considered to have the potential to impact upon Glennies Creek. The subject land does have connectivity with the Hunter River though, and indirect impacts are possible through adverse changes in water quality and quantity; however, management measures developed to mitigate the identified risks, as would be specified in the CEMP and OEMP mean the potential for the Project to impact upon entities protected under the FM Act is considered low and not assessed further in this report.

10 Biodiversity credit report

The Applicant commits to offsetting through a combination of transfer and retirement of biodiversity credits, and paying into the BCT Offset Fund. The following biodiversity credits are required to be retired:

- PCT 3431 – 817 credits.
- PCT 4015 – 3 credits.
- Striped Legless Lizard – 660 credits.
- Brush-tailed Phascogale – 167 credits.
- Southern Myotis – 608 credits.
- Powerful Owl – 55 credits.

A biodiversity credit report is provided on the following pages.

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00037099/BAAS18155/22/00037100	Maison Dieu Solar Farm Current	14/03/2024
Assessor Name	Report Created	BAM Data version *
Brendon True	29/05/2024	67
Assessor Number	BAM Case Status	Date Finalised
BAAS18155	Open	To be finalised
Assessment Revision	Assessment Type	
9	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Ecosystem credits
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Central Hunter Ironbark Grassy Woodland

1	3431_DNG_Low	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	6.6	6.6	19.1	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		0
2	3431_DNG_Moderate	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	28.5	28.5	45.8	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		653
3	3431_High	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	63.9	63.9	0.07	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		2

BAM Credit Summary Report

4	3431_Reg en	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	49.2	49.2	1.8	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		43
5	3431_Low	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	26.5	26.5	9	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		119
											Subtotal	817
Central Hunter Riparian Forest												
6	4015_Moderate	Not a TEC	62.2	62.2	0.1	PCT Cleared - 88%	High Sensitivity to Gain			2.00		3
											Subtotal	3
											Total	820

Species credits for threatened species

BAM Credit Summary Report

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAI	Species credits
<i>Delma impar / Striped Legless Lizard (Fauna)</i>									
3431_DNG_Low	6.6	6.6	19.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	47
3431_DNG_Moderate	28.5	28.5	45.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	490
3431_High	63.9	63.9	0.07	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	2
3431_Regen	49.2	49.2	1.8	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	32

BAM Credit Summary Report

3431_Low	26.5	26.5	9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Vulnerable	False	89
								Subtotal	660
<i>Myotis macropus / Southern Myotis (Fauna)</i>									
3431_DNG_Low	6.6	6.6	11.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	39
3431_DNG_Moderate	28.5	28.5	30.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	434
3431_High	63.9	63.9	0.05	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2
3431_Regen	49.2	49.2	1.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	42
3431_Low	26.5	26.5	6.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	91
								Subtotal	608

<i>Ninox strenua</i> / Powerful Owl (Fauna)									
3431_Low	26.5	26.5	3.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	52
4015_Moderate	62.2	62.2	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	3
								Subtotal	55
<i>Phascogale tapoatafa</i> / Brush-tailed Phascogale (Fauna)									
3431_High	63.9	63.9	0.07	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2
3431_Regen	49.2	49.2	1.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	43
3431_Low	26.5	26.5	9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	119
4015_Moderate	62.2	62.2	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	3
								Subtotal	167

11 Biodiversity offset strategy

11.1 Offsetting options

To secure the above offset liability detailed in Section 6.1, Section 8, and Section 10, the Applicant has three main options, and a fourth potential option, in relation to Striped Legless Lizard/Hunter Valley Delma, which include:

- Payment to the Biodiversity Conservation Fund (the Fund) managed by the Biodiversity Conservation Trust (BCT).
- Purchase of credits from the open market.
- Establishment of a Biodiversity Stewardship Site(s) to generate credits for offsetting the Project specifically.
- Funding a conservation action.

An overview of each of the options is briefly outlined below. It is likely and preferred that option 1 and/or option 2 would be the preferred option at his time.

Option 1: Payment to the Biodiversity Offset Fund managed by the BCT

Satisfying an offset obligation by paying to the Biodiversity Offset Fund (the Fund) has the major benefit of being an expedited and unambiguous way for a proponent to meet their obligations. However, it does include increased costs associated with the 'Risk premium', and an administrative cost per credit added on top of the costs to source/generate the credits, calculated by the BCT. As such, Payment to the Fund is considered likely to be the most expensive option available to a proponent, however it requires the least amount of time and effort in offset security, which can both be substantial (e.g., compared to establishing a Stewardship Site).

Option 2: Purchase credits from the open market

Biodiversity credits exist in an open market-based system whereby an owner of a Biodiversity Stewardship Site, who has generated a range of biodiversity credits, lists their credits in an online database for proponents with a credit obligation to interrogate and enter into price negotiations with relevant credit holders. As an open market, the price of credits is set by supply and demand factors as well as requirements for credits generated at a Biodiversity Stewardship Site to be sold for at least the minimum portion each credit contributes to the management costs of that site (Part A cost, further detailed below). Initial credit sales must all go to funding the management actions required to be undertaken at the Biodiversity Stewardship Site (the costing of which is termed the 'Total Fund Deposit' [TFD]), however once the TFD has been fully satisfied, any future credit sales are generally direct profit to the credit owner.

Option 3: Establish a Biodiversity Stewardship Site

Establishment of a Biodiversity Stewardship Site (or multiple sites) with the intention of generating credits to satisfy the Project's offset obligation is considered likely to be the most suitable option available to Terrain Solar for the Project. This is partly due to the quantum of offsets required for the Project, and the associated cost of securing those offsets through either the open credit market or via payment to the Fund. The suitability of this option is dependent on securing land that is both suitable for the establishment of a

Biodiversity Stewardship Site and supports PCTs/habitats considered Like-for-Like with those impacted by the Project. Establishing local Biodiversity Stewardship Sites provides the greatest benefit to locally occurring (and impacted) biodiversity values by establishing offsets and undertaking ecological restoration in the local area, potentially allowing for the benefits to be realised by populations of species impacted by the Project.

Although the procurement of local offsets is preferred, securing of offsets is governed by the offset rules outlined in Section 10.2 of the BAM. AGLM is committed to purchase of matching credits from the market, or payment to the Fund.

Option 4: Ancillary rules: Biodiversity Conservation Actions

In the case of the Striped Legless Lizard, or data deficient status of the newly described Hunter Valley Delma, funding a biodiversity conservation action that benefits the threatened species, habitat or ecological community maybe a viable option. Although not a listed species with prescribed conservation actions as per ancillary rules, investigations into the viability of conservation actions could be undertaken in consultation with BCS and BCT, and generate a positive environmental outcome for this species.

12 Conclusion

Biosis was engaged by RPS to undertake a biodiversity assessment (this BDAR) of the Maison Dieu Solar Farm at Maison Dieu, near Singleton in NSW for Terrain Solar Pty Ltd. The Project would construct, operate and maintain a solar farm and BESS with a capacity of up to 60 MW and 40 MW with 2-hour storage respectively. The Project would also install a transmission connection to the existing Maison Dieu Substation.

The Project is considered SSD and would be assessed under Part 4 of the EP&A Act. The Project triggers the BOS) and this BDAR serves as the assessment required by the BAM and BC Act.

Field investigation of the subject land in accordance with the BAM recorded 194.26 hectares of native vegetation, comprised of the following PCTs and TECs listed under the BC Act and EPBC Act:

- 175.92 hectares of PCT 3431 - Central Hunter Ironbark Grassy Woodland.
- 58.72 hectares represents Central Hunter Grey Box Ironbark Woodland (Endangered, BC Act).
- 43.17 hectares represents *Central Hunter Valley Eucalypt Forest and Woodland* (Critically Endangered, EPBC Act).
- 18.35 hectares of PCT 4015 - Central Hunter Swamp Oak Riparian Forest.
- 12.67 hectares represents Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Endangered, EPBC Act).

Targeted and incidental survey for threatened species recorded the following species as present within the subject land:

- Eastern Coastal Free-tailed Bat (Vulnerable, BC Act).
- Eastern False Pipistrelle (Vulnerable, BC Act).
- Greater Broad-nosed Bat (Vulnerable, BC Act).
- Yellow-bellied Sheath-tail-bat (Vulnerable, BC Act).
- Eastern Cave Bat (Vulnerable, BC Act).
- Large Bent-winged Bat (Vulnerable, BC Act).
- Large-eared Pied Bat (Vulnerable, BC Act and EPBC Act).
- Little Bent-winged Bat (Vulnerable, BC Act).
- Grey-crowned Babbler (Vulnerable, BC Act)
- Speckled Warbler (Vulnerable, BC Act).
- Grey-headed Flying-fox (Vulnerable, BC Act and EPBC Act)
- Striped Legless Lizard (Vulnerable, BC Act and EPBC Act)
- Brush-tailed Phascogale (Vulnerable, BC Act)
- Southern Myotis (Vulnerable, BC Act)
- Powerful Owl (Vulnerable, BC Act)

Consideration has been given to avoiding and minimising impacts to biodiversity, where possible, especially during the assessment and preliminary design. Mitigation and management measures will be put in place to adequately address direct, indirect and prescribed impacts associated with the Project.

For impacts that are unavoidable, the following biodiversity credits are required for the Project, in accordance with Section 10 of the BAM:

- PCT 3431 – 817 credits for 75.74 ha of impact.
- PCT 4015 – 3 credits for 0.10 ha of impact
- Striped Legless Lizard – 660 credits for 79.15 ha of impact.
- Brush-tailed Phascogale – 167 credits for 10.89 ha of impact.
- Southern Myotis – 608 credits for 53.26 ha of impact.
- Powerful Owl – 55 credits for 4.02 ha of impact.

Detailed framework of mitigation measures including adaptive management and monitoring is proposed.

Impacts to the other threatened species recorded within the subject land have been assessed and in this report and no formal offsetting, above the retirement of the above biodiversity credits, is required under the BAM.

Referral of the Project was made to the Minister for the Cth DCCEWW with the referral decision dated 31 January 2024 stating the Project is a Controlled Action under the relevant controlling provisions of listed threatened species and communities. As such, assessment and approval under the EPBC Act is required utilising the bilateral agreement with NSW before the Project can proceed. This BDAR serves as the required assessment.

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APPENDICES

Appendix 1 Survey methods

Appendix 1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2000, Harden 2002). All doubtful species names were verified with the online Australian Plant Name Index (Australian National Botanic Gardens & Australian National Herbarium 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 3.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the DCCEEW (DSEWPaC 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

Appendix 1.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by EES (SL100758, expiry date 30 May 2024). The BAM Assessment and quality review of the BDAR was carried out by Accredited Assessor/s Brendon True (BAAS18155), Rebecca Goodwin (BAAS17067) and Mitchell Palmer (BAAS17051).

Appendix 2 Fauna

Table A 1: Fauna species recorded at the subject land

Common name	Scientific name	BC Act status	EPBC Act status
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>		
Australian King Parrot	<i>Alisterus scapularis</i>		
Australian Magpie	<i>Cracticus tibicen</i>		
Australian Raven	<i>Corvus coronoides</i>		
Australian Wood Duck	<i>Chenonetta jubata</i>		
Barn Owl	<i>Tyto alba</i>		
Bearded Dragon	<i>Pogona barbata</i>		
Black faced Cuckoo Shrike	<i>Coracina novaehollandiae</i>		
Black Flying Fox	<i>Pteropus alecto</i>		
Broad palmed Frog	<i>Litoria latopalmata</i>		
Brown snouted Blind Snake	<i>Anilius wiedii</i>		
Brown Falcon	<i>Falco berigora</i>		
Brown Hare\Rabbit	<i>Rabbit sp.</i>		
Brown Quail	<i>Coturnix ypsilophora</i>		
Brown Thornbill	<i>Acanthiza pusilla</i>		
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		
Common Eastern Froglet	<i>Crinia signifera</i>		
Common Myna	<i>Sturnus tristis</i>		
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>		
Crested Pigeon	<i>Ocyphaps lophotes</i>		
Double barred Finch	<i>Taeniopygia bichenovii</i>		
Eastern Barn Owl	<i>Tyto javanica</i>		
Eastern Broad nosed Bat	<i>Scotorepens orion</i>		
Eastern Brown Snake	<i>Pseudonaja textilis</i>		
Eastern Coastal Free tailed Bat	<i>Micronomus norfolkensis</i>	VU	
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	VU	
Eastern Free tailed Bat	<i>Ozimops ridei</i>		
Eastern Grey Kangaroo	<i>Macropus giganteus</i>		
Eastern Horseshoe Bat	<i>Rhinolophus megaphyllus</i>		
Eastern Koel	<i>Eudynamys orientalis</i>		
Eastern Osprey	<i>Pandion cristatus</i>	VU	
Eastern Rosella	<i>Platycercus eximius</i>		
Eastern Water Dragon	<i>Intellagama lesueurii lesueurii</i>		
European cattle	<i>Bos taurus</i>		
Fox	<i>Vulpes vulpes</i>		
Galah	<i>Eolophus roseicapillus</i>		

Common name	Scientific name	BC Act status	EPBC Act status
Golden headed Cisticola	<i>Cisticola exilis</i>		
Golden Whistler	<i>Pachycephala pectoralis</i>		
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		
Greater Broad nosed Bat	<i>Scoteanax rueppellii</i>		
Grey headed Flying Fox	<i>Pteropus poliocephalus</i>	VU	VU
Grey crowned Babbler eastern subspecies	<i>Pomatostomus temporalis temporalis</i>	VU	
Honey bee	<i>Apis mellifera</i>		
Horse	<i>Equus caballus</i>		
House Mouse	<i>Mus musculus</i>		
Hunter Valley Delma*	<i>Delma vescolineata</i>		
Inland Broad nosed Bat	<i>Scotorepens balstoni</i>		
Jacky Lizard	<i>Amphibolurus muricatus</i>		
Lace Monitor	<i>Varanus varius</i>		
Large eared Pied Bat	<i>Chalinolobus dwyeri</i>	VU	VU
Large Bent winged Bat	<i>Miniopterus orianae oceanensis</i>	VU	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>		
Little Bent winged Bat	<i>Miniopterus australis</i>	VU	
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>		
Magpie Lark	<i>Grallina cyanoleuca</i>		
Masked Lapwing	<i>Vanellus miles</i>		
Nankeen Kestrel	<i>Falco cenchroides</i>		
Noisy Miner	<i>Manorina melanocephala</i>		
Olive backed Oriole	<i>Oriolus sagittatus</i>		
Pacific Black Duck	<i>Anas superciliosa</i>		
Peron's Tree Frog	<i>Litoria peronii</i>		
Pied Butcherbird	<i>Cracticus nigrogularis</i>		
Pied Currawong	<i>Strepera graculina</i>		
Rabbit	<i>Oryctolagus cuniculus</i>		
Red browed Finch	<i>Neochmia temporalis</i>		
Red rumped Parrot	<i>Psephotus haematonotus</i>		
Robust Ctenotus	<i>Ctenotus robustus</i>		
Rufous Whistler	<i>Pachycephala rufiventris</i>		
Southern Boobook	<i>Ninox novaeseelandiae</i>		
Southern Myotis	<i>Myotis macropus</i>	VU	
Southern Rainbow skink	<i>Carlia tetradactyla</i>		
Speckled Warbler	<i>Chthonicola sagittata</i>	VU	
Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>		
Straight browed Ctenotus	<i>Ctenotus spaldingi</i>		
Striated Pardalote	<i>Pardalotus striatus</i>		
Striped Legless Lizard	<i>Delma impar</i>	VU	VU
Sugar Glider	<i>Petaurus breviceps</i>		
Sulphur crested Cockatoo	<i>Cacatua galerita</i>		

Common name	Scientific name	BC Act status	EPBC Act status
Superb Fairy Wren	<i>Malurus cyaneus</i>		
Swamp Wallaby	<i>Wallabia bicolor</i>		
Tau emerald	<i>Hemicordulia tau</i>		
Tawny Frogmouth	<i>Podargus strigoides</i>		
Tree Martin	<i>Petrochelidon nigricans</i>		
Tree Skink	<i>Egernia striolata</i>		
Wedge tailed Eagle	<i>Aquila audax</i>		
Whistling Kite	<i>Haliastur sphenurus</i>		
White striped Free tailed Bat	<i>Tadarida australis</i>		
White faced Heron	<i>Egretta novaehollandiae</i>		
White winged Chough	<i>Corcorax melanorhamphos</i>		
Willie Wagtail	<i>Rhipidura leucophrys</i>		
Yellow bellied Sheath tailed Bat	<i>Saccolaimus flaviventris</i>	VU	
Yellow rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		
Zebra Finch	<i>Taeniopygia guttata</i>		

*Assessed as *Delma impar*

Appendix 3 Flora

Appendix 3.1 BAM plot field data

Table A 2: BAM plot floristics

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Fabaceae	<i>Grona varians</i>		0.2	20	0.2	30	1	100						
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet	0.1	5										
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed											0.4	
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily												
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily												
Asparagaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily	0.1	20										
Asphodelaceae	<i>Dianella caerulea</i>	Blue Flax-lily												
Asteraceae	<i>Calotis dentex</i>	Burr-daisy	0.1	5	0.1	10								
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting	0.5	70	0.2	50	5							
Asteraceae	<i>Calotis spp.</i>	None											0.2	100
Asteraceae	<i>Euchiton spp.</i>	None			0.2	100								
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-Daisy												
Asteraceae	<i>Sonchus spp.</i>	Sowthistle	0.2	100			0.1	20						
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed	0.5	100										
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	5		0.5	100								
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell			0.1	30							0.1	1
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	0.1	5	0.2	50								
Campanulaceae	<i>Wahlenbergia stricta</i>	Tall Bluebell	0.1	10										
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell					0.3	100						
Campanulaceae	<i>Lobelia purpurascens</i>	whiteroot	0.1	20										

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bullock	0.2	5	5									
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak											60	
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed	0.2	30										
Chenopodiaceae	<i>Einadia spp.</i>	None											0.2	
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	0.2	5	0.1	5								
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort									0.2		0.1	
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	0.1	5	0.1	20							1	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	0.1	5			0.2	50			0.2			
Convolvulaceae	<i>Convolvulus graminetinus</i>	None												
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge									0.2			
Cyperaceae	<i>Carex inversa</i>	Knob Sedge							10					
Cyperaceae	<i>Cyperus spp.</i>	None	0.1	30	0.1	40	0.1	20						
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge									0.1			
Cyperaceae	<i>Carex appressa</i>	Tall Sedge												
Fabaceae (Faboideae)	<i>Glycine spp.</i>	None												
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	Small-leaf Glycine	0.3	50										
Fabaceae (Faboideae)	<i>Desmodium spp.</i>	Tick-trefoil											0.2	
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine												
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine	0.5	40	1	200								
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle	3	60										
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium												
Geraniaceae	<i>Geranium homeanum</i>	None					0.1	20						
Geraniaceae	<i>Geranium solanderi var. grande</i>	None							0.2					
Geraniaceae	<i>Geranium spp.</i>	None					5							
Juncaceae	<i>Juncus usitatus</i>	None											2	

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Lamiaceae	<i>Mentha satureioides</i>	Native Pennyroyal									0.1			
Lamiaceae	<i>Mentha spp.</i>	None					0.1	10						
Lomandraceae	<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush	0.1	5										
Lomandraceae	<i>Lomandra spp.</i>	Mat-rush			0.1	5								
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush	0.1	5										
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida												
Malvaceae	<i>Malva spp.</i>	Mallow												
Monimiaceae	<i>Daphnandra micrantha</i>	None												
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box			15									
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	8										0.2	
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple											6	
Oxalidaceae	<i>Oxalis perennans</i>	None	0.1	30	0.1	20							0.2	
Phyllanthaceae	<i>Phyllanthus spp.</i>	None			0.1	20								
Plantaginaceae	<i>Veronica spp.</i>	None			0.1	20								
Plantaginaceae	<i>Plantago debilis</i>	Shade Plantain	0.1	10	0.1	20								
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell									0.1			
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	5		10									
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass									1			
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass											0.4	
Poaceae	<i>Cynodon dactylon</i>	Common Couch	5				20		40		25		55	
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass												
Poaceae	<i>Panicum effusum</i>	Hairy Panic			10						1			
Poaceae	<i>Dichelachne spp.</i>	None					10							
Poaceae	<i>Festuca spp.</i>	None	1	100										
Poaceae	<i>Lachnagrostis filiformis</i>	None												

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Poaceae	<i>Paspalidium distans</i>	None	1	200	1	200								
Poaceae	<i>Rytidosperma spp.</i>	None												
Poaceae	<i>Setaria spp.</i>	None					5	20						
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass			5									
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass							15		6			
Poaceae	<i>Bothriochloa macra</i>	Red Grass							3		10		8	
Poaceae	<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass											1	
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	5								10			
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass			5				20		25		15	
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	5											
Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass	30		5								8	
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris	10		5				15					
Poaceae	<i>Aristida benthamii</i>	Three-awned spear grass	5		10	300			2					
Poaceae	<i>Poa labillardierei var. labillardierei</i>	Tussock												
Poaceae	<i>Panicum simile</i>	Two-colour Panic												
Poaceae	<i>Paspalum distichum</i>	Water Couch											6	
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	2	300							2		30	
Poaceae	<i>Chloris truncata</i>	Windmill Grass					25							
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed												
Pteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern	0.1	20	0.1	20					0.1			
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff	0.3	40			1	50						
Rubiaceae	<i>Galium spp.</i>	None	0.2	100										
Rubiaceae	<i>Opercularia diphylla</i>	Stinkweed												
Rubiaceae	<i>Asperula asthenes</i>	Trailing Woodruff			0.2	30								
Scrophulariaceae	<i>Eremophila debilis</i>	Amulla	0.1	2	0.1	10								

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Scrophulariaceae	<i>Myoporum montanum</i>	Western Boobialla			0.1	2								
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr	0.1	5										
Verbenaceae	<i>Verbena spp.</i>	None												
Asteraceae	<i>Ambrosia artemisiifolia</i>	Annual Ragweed												
Asphodelaceae	<i>Asphodelus fistulosus</i>	Onion Weed					0.2	30						
Asteraceae	<i>Aster subulatus</i>	Wild Aster							0.1		0.1			
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs												
Poaceae	<i>Bromus catharticus</i>	Prairie Grass									0.5		3	
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's Purse												
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle												
Gentianaceae	<i>Centaurium erythraea</i>	Common Centaury									0.1		0.1	
Gentianaceae	<i>Centaurium spp.</i>	None												
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle												
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	0.1	20	0.2	20								
Asteraceae	<i>Conyza spp.</i>	None							0.1		0.1		0.2	
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery									0.5			
Cyperaceae	<i>Cyperus aggregatus</i>	None												
Cyperaceae	<i>Cyperus involucratus</i>	Umbrella Plant												
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass			1	200							7	
Poaceae	<i>Eleusine indica</i>	Crowsfoot Grass												
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass												
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot							2					
Aizoaceae	<i>Galenia pubescens</i>	Galenia	0.5	50	1	200	0.5	100						
Aizoaceae	<i>Galenia spp.</i>	None							0.5					
Asteraceae	<i>Gamochaeta spp.</i>	None					0.5	100	0.3					

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	0.2	10										
Apocynaceae	<i>Gomphocarpus spp.</i>	None												
Poaceae	<i>Hyparrhenia hirta</i>	Coolatai Grass												
Asteraceae	<i>Hypochaeris radicata</i>	Catsear							0.1					
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass							2		1			
Solanaceae	<i>Lycium ferocissimum</i>	African Boxthorn			5								0.2	
Primulaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel	0.5	50							0.1			
Fabaceae (Faboideae)	<i>Medicago spp.</i>	None			0.2	50	0.1	20						
Poaceae	<i>Melinis repens</i>	Red Natal Grass	5											
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow											0.2	
Oleaceae	<i>Olea europaea subsp. cuspidata</i>	African Olive	1	10										
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear												
Cactaceae	<i>Opuntia spp.</i>	None												
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear	0.1	3										
Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort	0.1	20			0.2	50						
Poaceae	<i>Paspalum dilatatum</i>	Paspalum							2		9		10	
Malvaceae	<i>Pavonia hastata</i>	None												
Caryophyllaceae	<i>Petrorhagia dubia</i>	None					0.1	50						
Caryophyllaceae	<i>Petrorhagia spp.</i>	None												
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	1	200	0.5	50	5		8		0.1		0.2	
Strelitziaceae	<i>Ravenala madagascariensis</i>	None												
Iridaceae	<i>Romulea rosea var. australis</i>	Onion Grass												
Polygonaceae	<i>Rumex crispus</i>	Curled Dock											0.1	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	3	300	1	200	5		10		0.1		0.1	
Poaceae	<i>Setaria palmifolia</i>	Palm Grass							10					

Family	Scientific name	Common name	MDSF_01		MDSF_02		MDSF_03		MDSF_04		MDSF_05		MDSF_06	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Poaceae	<i>Setaria parviflora</i>	None									20		3	
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	0.5	70	2	300	5		0.2				0.3	
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade												
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle												
Lamiaceae	<i>Stachys arvensis</i>	Stagger Weed					0.2	30						
Fabaceae (Faboideae)	<i>Trifolium arvense</i>	Haresfoot Clover	0.2	10			0.2	50						
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover							0.1					
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	None	0.1	30					0.1					
Caryophyllaceae	<i>Vaccaria hispanica</i>	Cow Soapwort					0.2	50						
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop					0.1	10	0.1		0.1			
Poaceae	<i>Vulpia bromoides</i>	Squirrel Tail Fesque	5											

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Fabaceae (Faboideae)	<i>Grona varians</i>				0.2		0.2							
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet												
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed	100											
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily												
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily												
Asparagaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily												
Asphodelaceae	<i>Dianella caerulea</i>	Blue Flax-lily			0.1	2								
Asteraceae	<i>Calotis dentex</i>	Burr-daisy												

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting					0.2						1	
Asteraceae	<i>Calotis spp.</i>	None					0.3	100						
Asteraceae	<i>Euchiton spp.</i>	None												
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-Daisy												
Asteraceae	<i>Sonchus spp.</i>	Sowthistle												
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed												
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy												
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell			0.2	50							0.1	
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	0.1	1										
Campanulaceae	<i>Wahlenbergia stricta</i>	Tall Bluebell												
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell												
Campanulaceae	<i>Lobelia purpurascens</i>	whiteroot												
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bullock			6		1							
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak												
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed											0.2	
Chenopodiaceae	<i>Einadia spp.</i>	None												
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	0.2						0.5		0.2			
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort												
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew												
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed											0.3	
Convolvulaceae	<i>Convolvulus graminetinus</i>	None											0.1	
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge			0.2		0.5		0.1		0.1		0.2	
Cyperaceae	<i>Carex inversa</i>	Knob Sedge			0.3									
Cyperaceae	<i>Cyperus spp.</i>	None												
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	0.1											

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Cyperaceae	<i>Carex appressa</i>	Tall Sedge												
Fabaceae (Faboideae)	<i>Glycine spp.</i>	None												
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	Small-leaf Glycine												
Fabaceae (Faboideae)	<i>Desmodium spp.</i>	Tick-trefoil												
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine											0.3	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine												
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle												
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium					0.5						0.1	
Geraniaceae	<i>Geranium homeanum</i>	None												
Geraniaceae	<i>Geranium solanderi var. grande</i>	None												
Geraniaceae	<i>Geranium spp.</i>	None												
Juncaceae	<i>Juncus usitatus</i>	None												
Lamiaceae	<i>Mentha satuireioides</i>	Native Pennyroyal												
Lamiaceae	<i>Mentha spp.</i>	None												
Lomandraceae	<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush												
Lomandraceae	<i>Lomandra spp.</i>	Mat-rush												
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush												
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida												
Malvaceae	<i>Malva spp.</i>	Mallow	0.3											
Monimiaceae	<i>Daphnandra micrantha</i>	None												
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box												
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark			30		25				15			
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple												
Oxalidaceae	<i>Oxalis perennans</i>	None	0.1						0.1					
Phyllanthaceae	<i>Phyllanthus spp.</i>	None												

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Plantaginaceae	<i>Veronica spp.</i>	None												
Plantaginaceae	<i>Plantago debilis</i>	Shade Plantain	0.1								0.4		0.3	
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell												
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass												
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass							0.1		0.5		10	
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass												
Poaceae	<i>Cynodon dactylon</i>	Common Couch	30		15		35		85		65		40	
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass											10	
Poaceae	<i>Panicum effusum</i>	Hairy Panic			10		15						4	
Poaceae	<i>Dichelachne spp.</i>	None												
Poaceae	<i>Festuca spp.</i>	None												
Poaceae	<i>Lachnagrostis filiformis</i>	None												
Poaceae	<i>Paspalidium distans</i>	None												
Poaceae	<i>Rytidosperma spp.</i>	None					7							
Poaceae	<i>Setaria spp.</i>	None												
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass												
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass			20		8							
Poaceae	<i>Bothriochloa macra</i>	Red Grass	15				3		2				8	
Poaceae	<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass												
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	2		2		3						2	
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	45		40		25		10		40		45	
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass												
Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass												
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris	1		7		15				4		8	
Poaceae	<i>Aristida benthamii</i>	Three-awned spear grass												

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Tussock												
Poaceae	<i>Panicum simile</i>	Two-colour Panic												
Poaceae	<i>Paspalum distichum</i>	Water Couch												
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	10		2		3							
Poaceae	<i>Chloris truncata</i>	Windmill Grass												
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed							0.1					
Pteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern			0.2									
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff					3							
Rubiaceae	<i>Galium</i> spp.	None												
Rubiaceae	<i>Opercularia diphylla</i>	Stinkweed												
Rubiaceae	<i>Asperula asthenes</i>	Trailing Woodruff												
Scrophulariaceae	<i>Eremophila debilis</i>	Amulla												
Scrophulariaceae	<i>Myoporum montanum</i>	Western Boobialla												
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr			0.1									
Verbenaceae	<i>Verbena</i> spp.	None									0.2			
Asteraceae	<i>Ambrosia artemisiifolia</i>	Annual Ragweed												
Asphodelaceae	<i>Asphodelus fistulosus</i>	Onion Weed												
Asteraceae	<i>Aster subulatus</i>	Wild Aster	0.1								0.1		0.1	
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs					0.1							
Poaceae	<i>Bromus catharticus</i>	Praire Grass	0.5						1		8		2	
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's Purse									0.4			
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle												
Gentianaceae	<i>Centaurium erythraea</i>	Common Centaury	0.1		0.1		0.1				0.1		0.1	
Gentianaceae	<i>Centaurium</i> spp.	None												
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	0.1		0.1		0.1				0.1		0.2	

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane			0.2						0.2			
Asteraceae	<i>Conyza spp.</i>	None	0.2					0.5		0.1			0.3	
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	0.3					0.5		0.2			0.2	
Cyperaceae	<i>Cyperus aggregatus</i>	None												
Cyperaceae	<i>Cyperus involucratus</i>	Umbrella Plant												
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass			0.5									
Poaceae	<i>Eleusine indica</i>	Crowsfoot Grass									1		1	
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass												
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot												
Aizoaceae	<i>Galenia pubescens</i>	Galenia			1									
Aizoaceae	<i>Galenia spp.</i>	None												
Asteraceae	<i>Gamochaeta spp.</i>	None												
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush												
Apocynaceae	<i>Gomphocarpus spp.</i>	None	0.1		0.1									
Poaceae	<i>Hyparrhenia hirta</i>	Coolatai Grass					1							
Asteraceae	<i>Hypochaeris radicata</i>	Catsear												
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass												
Solanaceae	<i>Lycium ferocissimum</i>	African Boxthorn									0.4		0.4	
Primulaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel			0.1		0.1						0.1	
Fabaceae (Faboideae)	<i>Medicago spp.</i>	None												
Poaceae	<i>Melinis repens</i>	Red Natal Grass												
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow					0.2						0.2	
Oleaceae	<i>Olea europaea subsp. cuspidata</i>	African Olive			0.5									
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear												
Cactaceae	<i>Opuntia spp.</i>	None			0.2									

Family	Scientific name	Common name	MDSF_07		MDSF_08		MDSF_09		MDSF_10		MDSF_11		MDSF_12	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear												
Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort												
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	20		15		8		8		7		15	
Malvaceae	<i>Pavonia hastata</i>	None												
Caryophyllaceae	<i>Petrorhagia dubia</i>	None												
Caryophyllaceae	<i>Petrorhagia spp.</i>	None												
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	0.1		0.3		0.3						0.2	
Strelitziaceae	<i>Ravenala madagascariensis</i>	None												
Iridaceae	<i>Romulea rosea var. australis</i>	Onion Grass												
Polygonaceae	<i>Rumex crispus</i>	Curled Dock												
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	1		2		0.4		0.3		0.3		0.5	
Poaceae	<i>Setaria palmifolia</i>	Palm Grass												
Poaceae	<i>Setaria parviflora</i>	None	15		10		4		2		10			
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne			5		5		0.3		0.3		0.4	
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade			0.1									
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	0.1								0.1			
Lamiaceae	<i>Stachys arvensis</i>	Stagger Weed												
Fabaceae (Faboideae)	<i>Trifolium arvense</i>	Haresfoot Clover												
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover									0.3			
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	None					0.1							
Caryophyllaceae	<i>Vaccaria hispanica</i>	Cow Soapwort												
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	0.1										0.2	
Poaceae	<i>Vulpia bromoides</i>	Squirrel Tail Fesque												

Family	Scientific name	Common name	MDSF_13		MDSF_14		MDSF_15		MDSF_16		MDSF_17		MDSF_18	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Fabaceae (Faboideae)	<i>Grona varians</i>												0.3	
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet												
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed												
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily												
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily												
Asparagaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily												
Asphodelaceae	<i>Dianella caerulea</i>	Blue Flax-lily												
Asteraceae	<i>Calotis dentex</i>	Burr-daisy												
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting			0.3						0.2		1	
Asteraceae	<i>Calotis spp.</i>	None												
Asteraceae	<i>Euchiton spp.</i>	None												
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-Daisy			0.4									
Asteraceae	<i>Sonchus spp.</i>	Sowthistle												
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed												
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy											0.4	
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell			0.1		0.2		0.3				0.2	
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	0.1											
Campanulaceae	<i>Wahlenbergia stricta</i>	Tall Bluebell												
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell												
Campanulaceae	<i>Lobelia purpurascens</i>	whiteroot												
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bulloak			0.2								1	
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak	30											
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed												
Chenopodiaceae	<i>Einadia spp.</i>	None	0.1		0.4								0.3	
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush			0.2									

Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort											
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew	0.3		0.2							0.2	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	1		0.3								
Convolvulaceae	<i>Convolvulus graminetinus</i>	None											
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	0.1		0.2		0.1					0.3	
Cyperaceae	<i>Carex inversa</i>	Knob Sedge			0.3								
Cyperaceae	<i>Cyperus spp.</i>	None											
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge											
Cyperaceae	<i>Carex appressa</i>	Tall Sedge	0.2										
Fabaceae (Faboideae)	<i>Glycine spp.</i>	None			0.2						0.2		0.4
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	Small-leaf Glycine											
Fabaceae (Faboideae)	<i>Desmodium spp.</i>	Tick-trefoil											
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine											
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine											
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle											
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium	0.1								0.3		
Geraniaceae	<i>Geranium homeanum</i>	None											
Geraniaceae	<i>Geranium solanderi var. grande</i>	None											
Geraniaceae	<i>Geranium spp.</i>	None											
Juncaceae	<i>Juncus usitatus</i>	None											
Lamiaceae	<i>Mentha satureioides</i>	Native Pennyroyal											
Lamiaceae	<i>Mentha spp.</i>	None											
Lomandraceae	<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush											
Lomandraceae	<i>Lomandra spp.</i>	Mat-rush										0.2	
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush			0.1								
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida										0.1	
Malvaceae	<i>Malva spp.</i>	Mallow											
Monimiaceae	<i>Daphnandra micrantha</i>	None											
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box											

Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark			40				10			20
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple										
Oxalidaceae	<i>Oxalis perennans</i>	None										0.2
Phyllanthaceae	<i>Phyllanthus spp.</i>	None										
Plantaginaceae	<i>Veronica spp.</i>	None										
Plantaginaceae	<i>Plantago debilis</i>	Shade Plantain					0.2					
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell										
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass										6
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	2									10
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass										
Poaceae	<i>Cynodon dactylon</i>	Common Couch					70		70		75	7
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass			8		3		6		1	7
Poaceae	<i>Panicum effusum</i>	Hairy Panic			9		6					7
Poaceae	<i>Dichelachne spp.</i>	None										
Poaceae	<i>Festuca spp.</i>	None										
Poaceae	<i>Lachnagrostis filiformis</i>	None	0.3									2
Poaceae	<i>Paspalidium distans</i>	None										
Poaceae	<i>Rytidosperma spp.</i>	None			15						1	
Poaceae	<i>Setaria spp.</i>	None										
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass										
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	8		10						6	20
Poaceae	<i>Bothriochloa macra</i>	Red Grass			2		2				3	8
Poaceae	<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass										
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass										10
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	3		35		30		35		35	25
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass										
Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass	1									
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris	6		5						7	5
Poaceae	<i>Aristida benthamii</i>	Three-awned spear grass										8

Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	Tussock											
Poaceae	<i>Panicum simile</i>	Two-colour Panic	7										
Poaceae	<i>Paspalum distichum</i>	Water Couch											
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	35	10								10	
Poaceae	<i>Chloris truncata</i>	Windmill Grass				2							
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed											
Pteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern	0.1									0.3	
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff											
Rubiaceae	<i>Galium</i> spp.	None											
Rubiaceae	<i>Opercularia diphylla</i>	Stinkweed		0.1									
Rubiaceae	<i>Asperula asthenes</i>	Trailing Woodruff											
Scrophulariaceae	<i>Eremophila debilis</i>	Amulla		0.5									
Scrophulariaceae	<i>Myoporum montanum</i>	Western Boobialla											
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr	0.1	0.2								0.2	
Verbenaceae	<i>Verbena</i> spp.	None											
Asteraceae	<i>Ambrosia artemisiifolia</i>	Annual Ragweed	0.1									0.2	
Asphodelaceae	<i>Asphodelus fistulosus</i>	Onion Weed											
Asteraceae	<i>Aster subulatus</i>	Wild Aster				0.1							
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	0.1	0.1			0.1						
Poaceae	<i>Bromus catharticus</i>	Praire Grass				3		1					
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's Purse		0.1			0.2						
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle								0.3			
Gentianaceae	<i>Centaurium erythraea</i>	Common Centaury				0.1				0.2		0.3	
Gentianaceae	<i>Centaurium</i> spp.	None		0.4									
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	0.2	0.1									
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane											
Asteraceae	<i>Conyza</i> spp.	None	0.2	0.3			0.3		0.1			0.2	
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	0.1	0.2						0.2		0.2	
Cyperaceae	<i>Cyperus aggregatus</i>	None				0.1		0.2		0.2		0.3	

Cyperaceae	<i>Cyperus involucratus</i>	Umbrella Plant											
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	30										
Poaceae	<i>Eleusine indica</i>	Crowsfoot Grass				1		3					
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass										1	
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot											
Aizoaceae	<i>Galenia pubescens</i>	Galenia			0.1			3				0.4	
Aizoaceae	<i>Galenia spp.</i>	None											
Asteraceae	<i>Gamochaeta spp.</i>	None	0.2		0.1	0.1				0.2		0.2	
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush											
Apocynaceae	<i>Gomphocarpus spp.</i>	None											
Poaceae	<i>Hyparrhenia hirta</i>	Coolatai Grass											
Asteraceae	<i>Hypochaeris radicata</i>	Catsear										0.1	
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass											
Solanaceae	<i>Lycium ferocissimum</i>	African Boxthorn	3										
Primulaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel			0.1	0.1						0.1	
Fabaceae (Faboideae)	<i>Medicago spp.</i>	None											
Poaceae	<i>Melinis repens</i>	Red Natal Grass											
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow				0.3		0.1		0.1			
Oleaceae	<i>Olea europaea subsp. cuspidata</i>	African Olive	25		3								
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear			0.1							0.2	
Cactaceae	<i>Opuntia spp.</i>	None			0.2							0.1	
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear											
Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort										0.1	
Poaceae	<i>Paspalum dilatatum</i>	Paspalum				10		3		2		3	
Malvaceae	<i>Pavonia hastata</i>	None	0.2										
Caryophyllaceae	<i>Petrorhagia dubia</i>	None											
Caryophyllaceae	<i>Petrorhagia spp.</i>	None										0.1	
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues			0.2	2		0.4		0.3		3	
Strelitziaceae	<i>Ravenala madagascariensis</i>	None				0.5							

Iridaceae	<i>Romulea rosea var. australis</i>	Onion Grass								0.1		0.3	
Polygonaceae	<i>Rumex crispus</i>	Curled Dock											
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	0.1		0.2				0.3		0.2		0.2
Poaceae	<i>Setaria palmifolia</i>	Palm Grass											
Poaceae	<i>Setaria parviflora</i>	None	3				20		10		6		4
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	0.5		0.3		0.1		0.5		0.4		0.3
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade											0.3
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle			0.1								
Lamiaceae	<i>Stachys arvensis</i>	Stagger Weed											
Fabaceae (Faboideae)	<i>Trifolium arvense</i>	Haresfoot Clover											
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover					0.2						
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	None							0.1				0.4
Caryophyllaceae	<i>Vaccaria hispanica</i>	Cow Soapwort											0.3
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	0.1										0.2
Poaceae	<i>Vulpia bromoides</i>	Squirrel Tail Fesque											

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Fabaceae (Faboideae)	<i>Grona varians</i>		0.4		0.4		0.5					
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet										
Amaranthaceae	<i>Alternanthera denticulata</i>	Lesser Joyweed										
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily									0.1	4
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily	0.2									
Asparagaceae	<i>Arthropodium milleflorum</i>	Pale Vanilla-lily										
Asphodelaceae	<i>Dianella caerulea</i>	Blue Flax-lily										
Asteraceae	<i>Calotis dentex</i>	Burr-daisy										
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting	0.3		0.3						0.2	50

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Asteraceae	<i>Calotis spp.</i>	None										
Asteraceae	<i>Euchiton spp.</i>	None										
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-Daisy										
Asteraceae	<i>Sonchus spp.</i>	Sowthistle										
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed										
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy			0.2							
Campanulaceae	<i>Wahlenbergia spp.</i>	Bluebell	0.3		0.2		0.1		0.1	3		
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell										
Campanulaceae	<i>Wahlenbergia stricta</i>	Tall Bluebell										
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell										
Campanulaceae	<i>Lobelia purpurascens</i>	whiteroot										
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bullock	0.2								0.2	1
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak										
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed										
Chenopodiaceae	<i>Einadia spp.</i>	None	0.2									
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush										
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort										
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew									0.1	1
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	0.4		0.3						0.1	1
Convolvulaceae	<i>Convolvulus graminetinus</i>	None										
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	0.3		0.3							
Cyperaceae	<i>Carex inversa</i>	Knob Sedge										
Cyperaceae	<i>Cyperus spp.</i>	None										
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge										
Cyperaceae	<i>Carex appressa</i>	Tall Sedge										

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Fabaceae (Faboideae)	<i>Glycine spp.</i>	None							0.2	3	0.1	1
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	Small-leaf Glycine										
Fabaceae (Faboideae)	<i>Desmodium spp.</i>	Tick-trefoil										
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine										
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine										
Fabaceae (Mimosoideae)	<i>Acacia amblygona</i>	Fan Wattle										
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium	0.2		0.3		0.3		0.2	30		
Geraniaceae	<i>Geranium homeanum</i>	None										
Geraniaceae	<i>Geranium solanderi var. grande</i>	None										
Geraniaceae	<i>Geranium spp.</i>	None										
Juncaceae	<i>Juncus usitatus</i>	None	0.2									
Lamiaceae	<i>Mentha satureioides</i>	Native Pennyroyal	0.4									
Lamiaceae	<i>Mentha spp.</i>	None										
Lomandraceae	<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush									0.1	1
Lomandraceae	<i>Lomandra spp.</i>	Mat-rush										
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush										
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	0.5								0.2	100
Malvaceae	<i>Malva spp.</i>	Mallow										
Monimiaceae	<i>Daphnandra micrantha</i>	None			5							
Myrtaceae	<i>Eucalyptus moluccana</i>	Grey Box									25	
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark			8							
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple										
Oxalidaceae	<i>Oxalis perennans</i>	None	0.2									
Phyllanthaceae	<i>Phyllanthus spp.</i>	None										
Plantaginaceae	<i>Veronica spp.</i>	None										

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Plantaginaceae	<i>Plantago debilis</i>	Shade Plantain										
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell										
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	10				15					
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass										
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass										
Poaceae	<i>Cynodon dactylon</i>	Common Couch	20		20		40		55		5	
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass			3							
Poaceae	<i>Panicum effusum</i>	Hairy Panic			10		7					
Poaceae	<i>Dichelachne spp.</i>	None										
Poaceae	<i>Festuca spp.</i>	None										
Poaceae	<i>Lachnagrostis filiformis</i>	None										
Poaceae	<i>Paspalidium distans</i>	None	10									
Poaceae	<i>Rytidosperma spp.</i>	None	10		10		1				10	
Poaceae	<i>Setaria spp.</i>	None										
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass										
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	20		15		8		6			
Poaceae	<i>Bothriochloa macra</i>	Red Grass	10		10		10		7			
Poaceae	<i>Rytidosperma pallidum</i>	Redanther Wallaby Grass										
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	15									
Poaceae	<i>Sporobolus creber</i>	Slender Rat's Tail Grass	15		15		25		35		70	
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass										
Poaceae	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass										
Poaceae	<i>Chloris ventricosa</i>	Tall Chloris	10		10		15		7		5	
Poaceae	<i>Aristida benthamii</i>	Three-awned spear grass										
Poaceae	<i>Poa labillardierei var. labillardierei</i>	Tussock									2	500

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Poaceae	<i>Panicum simile</i>	Two-colour Panic										
Poaceae	<i>Paspalum distichum</i>	Water Couch										
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass			10							
Poaceae	<i>Chloris truncata</i>	Windmill Grass										
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed										
Pteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern										
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff	5		2							
Rubiaceae	<i>Galium spp.</i>	None										
Rubiaceae	<i>Opercularia diphylla</i>	Stinkweed										
Rubiaceae	<i>Asperula asthenes</i>	Trailing Woodruff										
Scrophulariaceae	<i>Eremophila debilis</i>	Amulla										
Scrophulariaceae	<i>Myoporum montanum</i>	Western Boobialla										
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr										
Verbenaceae	<i>Verbena spp.</i>	None	0.2		0.5							
Asteraceae	<i>Ambrosia artemisiifolia</i>	Annual Ragweed										
Asphodelaceae	<i>Asphodelus fistulosus</i>	Onion Weed										
Asteraceae	<i>Aster subulatus</i>	Wild Aster	0.1									
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs										
Poaceae	<i>Bromus catharticus</i>	Praire Grass										
Brassicaceae	<i>Capsella bursa-pastoris</i>	Shepherd's Purse										
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle										
Gentianaceae	<i>Centaurium erythraea</i>	Common Centaury	0.3		0.2				0.1	1		
Gentianaceae	<i>Centaurium spp.</i>	None										
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle			0.2							
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	0.2						0.2	20		

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Asteraceae	<i>Conyza spp.</i>	None			0.4		0.2					
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	0.4		0.4		0.3					
Cyperaceae	<i>Cyperus aggregatus</i>	None	0.4				0.3					
Cyperaceae	<i>Cyperus involucratus</i>	Umbrella Plant	0.3									
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass										
Poaceae	<i>Eleusine indica</i>	Crowsfoot Grass										
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass					1					
Geraniaceae	<i>Erodium cicutarium</i>	Common Crowfoot										
Aizoaceae	<i>Galenia pubescens</i>	Galenia	0.5		3		0.2		0.5	50	0.5	100
Aizoaceae	<i>Galenia spp.</i>	None										
Asteraceae	<i>Gamochaeta spp.</i>	None			0.2							
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush										
Apocynaceae	<i>Gomphocarpus spp.</i>	None									0.1	1
Poaceae	<i>Hyparrhenia hirta</i>	Coolatai Grass										
Asteraceae	<i>Hypochaeris radicata</i>	Catsear										
Poaceae	<i>Lolium perenne</i>	Perennial Ryegrass										
Solanaceae	<i>Lycium ferocissimum</i>	African Boxthorn			1						0.1	1
Primulaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel					0.2					
Fabaceae (Faboideae)	<i>Medicago spp.</i>	None										
Poaceae	<i>Melinis repens</i>	Red Natal Grass										
Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	0.4		0.4		0.3		0.3	30		
Oleaceae	<i>Olea europaea subsp. cuspidata</i>	African Olive										
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear									0.1	3
Cactaceae	<i>Opuntia spp.</i>	None			0.3						0.1	4
Cactaceae	<i>Opuntia stricta</i>	Common Prickly Pear										

Family	Scientific name	Common name	MDSF_19		MDSF_20		MDSF_21		MDSF_22		MDSF_23	
			Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund	Cvr%	Abund
Caryophyllaceae	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort										
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	6		6				2	300		
Malvaceae	<i>Pavonia hastata</i>	None										
Caryophyllaceae	<i>Petrorhagia dubia</i>	None										
Caryophyllaceae	<i>Petrorhagia spp.</i>	None										
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	2		4		4		1	300	0.3	200
Strelitziaceae	<i>Ravenala madagascariensis</i>	None										
Iridaceae	<i>Romulea rosea var. australis</i>	Onion Grass										
Polygonaceae	<i>Rumex crispus</i>	Curled Dock										
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	1				0.5		0.2	30	0.2	20
Poaceae	<i>Setaria palmifolia</i>	Palm Grass										
Poaceae	<i>Setaria parviflora</i>	None							5			
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	0.5		2		0.3		0.5	70	0.2	30
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade										
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	0.2									
Lamiaceae	<i>Stachys arvensis</i>	Stagger Weed	0.2									
Fabaceae (Faboideae)	<i>Trifolium arvense</i>	Haresfoot Clover										
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover										
Fabaceae (Faboideae)	<i>Trifolium spp.</i>	None	0.3				0.2					
Caryophyllaceae	<i>Vaccaria hispanica</i>	Cow Soapwort	0.4									
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop					0.6		0.1	2		
Poaceae	<i>Vulpia bromoides</i>	Squirrel Tail Fesque										

Table A 3: BAM plot summary

					Composition						Structure					
Plot ID	Zone	Easting	Northing	Bearing	Tree	Shrub	Grass	Forbs	Ferns	Other	Tree	Shrub	Grass	Forbs	Ferns	Other
MDSF_01	56	319448	6399258	85	2	5	13	16	1	3	8.2	3.5	69.3	7.8	0.1	1.0
MDSF_02	56	319711	6399168	265	2	5	10	10	1	2	20.0	0.5	51.2	1.8	0.1	1.2
MDSF_03	56	319693	6399299	300	0	0	5	8	0	1	0.0	0.0	60.1	11.8	0.0	1.0
MDSF_04	56	319248	6399237	230	0	0	7	1	0	0	0.0	0.0	105.0	0.2	0.0	0.0
MDSF_05	56	321485	6401040	170	0	0	10	4	1	0	0.0	0.0	80.3	0.6	0.1	0.0
MDSF_06	56	320868	6400967	152	3	0	9	7	0	1	66.2	0.0	125.4	2.2	0.0	0.2
MDSF_07	56	320562	6400982	344	0	1	7	4	0	0	0.0	0.2	103.1	0.6	0.0	0.0
MDSF_08	56	319837	6400869	189	2	1	9	2	1	1	36.0	0.1	96.5	0.3	0.2	0.2
MDSF_09	56	319893	6400503	220	2	0	10	4	0	1	26.0	0.0	114.5	4.0	0.0	0.2
MDSF_10	56	319080	6400128	344	0	1	5	2	0	0	0.0	0.5	97.2	0.2	0.0	0.0
MDSF_11	56	319016	6400174	280	1	1	5	2	0	0	15.0	0.2	109.6	0.6	0.0	0.0
MDSF_12	56	319230	6400528	45	0	0	9	6	0	2	0.0	0.0	127.2	2.0	0.0	0.4
MDSF_13	56	318965	6400755	224	1	1	10	5	1	0	30.0	0.1	62.6	1.6	0.1	0.0
MDSF_14	56	319376	6400487	171	2	3	11	7	0	1	40.2	0.9	94.6	1.8	0.0	0.2
MDSF_15	56	318676	6399706	200	0	0	7	2	0	0	0.0	0.0	113.1	0.4	0.0	0.0
MDSF_16	56	318746	6399717	104	1	0	3	1	0	0	10.0	0.0	111.0	0.3	0.0	0.0
MDSF_17	56	319235	6399639	258	0	0	7	2	0	1	0.0	0.0	128.0	0.5	0.0	0.2
MDSF_18	56	319635	6399893	180	2	1	15	7	1	2	21.0	0.2	125.5	2.4	0.3	0.7
MDSF_19	56	319735	6400136	94	1	0	11	11	0	1	0.2	0.0	120.5	7.9	0.0	0.4
MDSF_20	56	319464	6399751	298	2	0	10	7	0	1	13.0	0.0	103.3	3.8	0.0	0.4
MDSF_21	56	319342	6399795	16	0	0	8	2	0	1	0.0	0.0	121.0	0.4	0.0	0.5
MDSF_22	56	319341	6399748	11	0	0	5	2	0	1	0.0	0.0	110.0	0.3	0.0	0.2
MDSF_23	56	319462	6399505	160	2	0	6	5	0	1	25.2	0.0	92.1	0.7	0.0	0.1

					Function										
Plot ID	Zone	Easting	Northing	Bearing	Large Trees	Hollow Trees	Litter Cover	Length Fallen Logs	Tree Stem 5to9	Tree Stem 10to19	Tree Stem 20to29	Tree Stem 30to49	Tree 50to79	Tree Regen	High Threat Exotic
MDSF_01	56	319448	6399258	85	1	2	95	18	1	1	0	0	0	1	3.5
MDSF_02	56	319711	6399168	265	1	0	64	1	1	1	1	0	0	1	8.0
MDSF_03	56	319693	6399299	300	0	0	90	0	1	0	0	0	0	1	5.5
MDSF_04	56	319248	6399237	230	0	0	27	0	0	0	0	0	0	0	12.0
MDSF_05	56	321485	6401040	170	0	0	5	0	0	0	0	0	0	0	9.1
MDSF_06	56	320868	6400967	152	1	1	9	5	1	1	1	1	1	1	17.3
MDSF_07	56	320562	6400982	344	0	0	8	0	0	0	0	0	0	0	21.0
MDSF_08	56	319837	6400869	189	1	1	30	5	1	1	1	1	1	1	18.7
MDSF_09	56	319893	6400503	220	1	0	20	10	1	1	1	1	0	1	9.5
MDSF_10	56	319080	6400128	344	0	0	1	0	0	0	0	0	0	1	8.3
MDSF_11	56	319016	6400174	280	0	1	12	2	0	0	0	1	1	1	7.7
MDSF_12	56	319230	6400528	45	0	0	2	0	0	0	0	0	0	0	15.9
MDSF_13	56	318965	6400755	224	0	0	70	15	1	0	1	1	2	1	33.2
MDSF_14	56	319376	6400487	171	1	0	59	6	1	1	1	0	1	1	0.7
MDSF_15	56	318676	6399706	200	0	0	4	0	0	0	0	0	0	0	10.0
MDSF_16	56	318746	6399717	104	0	1	6	0	0	0	0	1	0	1	6.4
MDSF_17	56	319235	6399639	258	0	0	4	0	0	0	0	0	0	0	2.6
MDSF_18	56	319635	6399893	180	1	0	52	7	1	1	1	1	1	1	5.2
MDSF_19	56	319735	6400136	94	0	0	11	0	0	0	0	0	0	1	7.5
MDSF_20	56	319464	6399751	298	0	0	26	0	0	0	0	0	2	1	10.3
MDSF_21	56	319342	6399795	16	0	0	7	0	0	0	0	0	0	0	1.7
MDSF_22	56	319341	6399748	11	0	1	15	0	0	0	0	0	0	0	2.7
MDSF_23	56	319462	6399505	160	1	0	13	5	1	1	1	0	0	1	1.0

Appendix 4 BAM Candidate species assessment

Table A 4: Threatened flora species assessment

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
<i>Acacia pendula</i> population in the Hunter catchment	-	EP	Erect or spreading tree known from six locations in the Hunter Valley from Warkworth in the east, Muswellbrook to the north-west and Wybong to the west. Grows near river systems in Western Slopes Dry Sclerophyll Forests and Coastal Valley Grassy Woodlands. Grows on floodplains in heavy clay soils.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Angophora inopina</i> Charmhaven Apple	V	V	Occurs most frequently in four main vegetation communities: (i) <i>Eucalyptus haemastoma</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest; (ii) <i>Hakea teretifolia</i> – <i>Banksia oblongifolia</i> wet heath; (iii) <i>Eucalyptus resinifera</i> – <i>Melaleuca sieberi</i> – <i>Angophora inopina</i> sedge woodland; (iv) <i>Eucalyptus capitellata</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest.	Low	No	Habitat and incidental only	Negligible	This species was not generated by the BAM-C as a potential candidate species as it is not associated with the PCTs present with the subject land. Typically, this species inhabits sandy geologies within 30 km of the coast, however, one outlier record is present 20 km east of the subject land near Mitchells Flat which represents the western limit of the species known distribution (NSW DCCEEW 2024). None of the commonly associated species are present within the subject

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
								land. Furthermore, the species would be conspicuous in a landscape where the canopy is dominated by <i>Eucalyptus</i> spp. No SIC undertaken due to low likelihood of occurrence.
<i>Cymbidium canaliculatum</i> population in the Hunter catchment		EP	Epiphytic Orchid with a scattered distribution extending from the Hunter River in NSW to Cape York in Queensland and beyond through the Northern Territory to the Kimberley region in Western Australia. Grows in the hollows, fissures, cracks and forks of trees in Western Slopes Dry Sclerophyll Forests and Coastal Valley Grassy Woodlands. Grows on permian sediments.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Cynanchum elegans</i> White-flowered Wax Plant	E	E	Climbing vine restricted to eastern NSW from Brunswick Heads to Gerroa in the Illawarra region. Grows in rainforest gully scrub and scree slope on the edge of dry rainforests in a variety of communities including Coastal Floodplain Wetlands, Maritime Grasslands, Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests.	Low	No	No	Negligible	This species was not generated by the BAM-C as a potential candidate species as it is not associated with the PCTs present with the subject land. The subject land does not contain nor fringe the dry rainforest or more mesic vegetation types that this species more commonly inhabits. No SIC undertaken due to low likelihood of occurrence.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
<i>Diuris tricolor</i> Pine Donkey Orchid	-	V	Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (<i>Callitris</i> spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Usually recorded as common and locally frequent in populations, however only one or two plants have also been observed at sites. The species has been noted as growing in large colonies.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Diuris tricolor</i> - endangered population Pine Donkey Orchid population in the Muswellbrook local government area	-	EP	Found in sclerophyll woodland and derived grassland on flats or small rises, on a range of substrates including sandy or loamy soils. The habitat of <i>Diuris tricolor</i> in the Muswellbrook LGA has been fragmented by past land clearing.	None	No	Not required	None	The subject land is within the Muswellbrook LGA, therefore, no further assessment is required.
<i>Eucalyptus glaucina</i> Slaty Red Gum	V	V	Medium sized tree, confined to the north coast of NSW at Casino as well as Taree to Broke, west of Maitland. Grows in a variety of communities including Hunter - Macleay Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Northern Hinterland Wet Sclerophyll Forests and Coastal Valley	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys. No SIC undertaken as the species is considered not to occur.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			Grassy Woodlands. Grows on deep, moderately fertile, well-watered soils.					
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flower Grevillea	V	V	Low spreading to erect shrub sporadically distributed throughout the Sydney Basin, most notably in the Picton, Appin and Bargo regions, in the Cessnock - Kurri Kurri area and isolated populations from Putty to Wyong and Lake Macquarie. Grows in Shale Sandstone Transition Forest, Kurri Sand Swamp Woodland, <i>Corymbia maculata</i> - <i>Angophora costata</i> Open Forest in the Dooralong Area, Sydney Sandstone Ridgetop Woodland at Wedderburn and Cooks River/Castlereagh Ironbark Forest at Kemps Creek. Grows in sandy or light clay soils including tertiary alluviums over thin shales and lateritic ironstone gravels.	Low	No	No	Negligible	This species was not generated by the BAM-C as a potential candidate species as it is not associated with the PCTs present with the subject land. The species prefers sandy soils that the subject does not contain. No SIC undertaken due to low likelihood of occurrence.
<i>Ozothamnus tessellatus</i>	V	V	Grows in Eucalypt woodland. <i>Ozothamnus tessellatus</i> is restricted to a few locations north of Rylstone, NSW. This species has been collected at eight sites in a restricted area over a range of 300 km ² .	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Persoonia pauciflora</i> North Rothbury Persoonia	CE	CE	It is found in dry open forest or woodland dominated by Spotted Gum (<i>Corymbia maculata</i>), Broad-leaved Ironbark (<i>Eucalyptus fibrosa</i>) and/or Narrow-leaved Ironbark (<i>E. crebra</i>) and supporting a moderate to sparse shrub	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			layer and grassy groundcover. Disturbance events such as grazing, fire and slashing have impacted on both the size and age structure of the population. Plants are absent from comparable habitat that is grazed and/or frequently burnt or slashed.					
<i>Pomaderris queenslandica</i> Scant Pomaderris	-	E	Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Prasophyllum petilum</i> Tarengo Leek Orchid	E	E	Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock <i>Poa labillardieri</i> , Black Gum <i>Eucalyptus aggregata</i> and tea-trees <i>Leptospermum</i> spp. near Queanbeyan and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford. Apparently highly susceptible to grazing, being retained only at little-grazed travelling stock reserves (Boorowa & Delegate) and in cemeteries (near Queanbeyan, Ilford and Hall). Plants retreat into subterranean tubers after fruiting, so are not visible above-ground outside of growing periods.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
<i>Prasophyllum sp. Wybong</i>	CR	-	Terrestrial orchid restricted to five sites within NSW at Boorowa, Captains Flat, Ilford, a Travelling Stock Route at Delegate and 10 kilometres south-east of Muswellbrook. Found growing in open sites and patchy forest in Natural Temperate Grassland, Box-Gum Woodlands, Temperate Montane Grasslands, Southern Tableland Grassy Woodlands, Subalpine Woodlands, Tableland Clay Grassy Woodlands, Western Slopes Grassy Woodlands. This species is cryptic and most visible when flowering between October and December. Grows in fertile soils.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Pterostylis chaetophora</i>	-	V	A terrestrial orchid known from 18 scattered locations in a relatively small area between Taree and Kurri Kurri, extending to the south-east towards Tea Gardens and west into the Upper Hunter, with additional records near Denman and Wingen and isolated records from the Sydney region. Grows in seasonally moist, dry sclerophyll forest with a grass and shrub understorey.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
<i>Rutidosia heterogama</i> Heath Wrinklewort	V	V	Small perennial herb with populations located in the Cessnock to Kurri Kurri area with outlying occurrences at Howes Valley, from Wyong to Newcastle on the Central Coast and Wooli to Evans Head in Yuraygir and Bundjalung National Parks and in New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows mostly in heath and along roadsides in coastal districts in a variety of communities including North-west Slopes Dry Sclerophyll Woodlands, Western Slopes Dry Sclerophyll Forests, Northern Tableland Wet Sclerophyll Forests, Maritime Grasslands, Coastal Headland Heaths and Wallum Sand Heaths. Grows in sandy soils.	Low	No	No	Negligible	This species was not generated by the BAM-C as a potential candidate species as it is not associated with the PCTS present with the subject land. The subject land is approximately 20 kilometres north-west of the known western limit of the species distribution in the Hunter Valley. The species prefers sandy soils that the subject does not contain. No SIC undertaken due to low likelihood of occurrence.

Table A 5: Threatened fauna species assessment

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
Birds								
<i>Anthochaera phrygia</i> Regent Honeyeater	CR	CR	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.	Low	No	Not required	Low	The subject land is not mapped as Important Habitat for this species, the nearest being at Singleton Military Are approximately 19 km to the south-east. Therefore, this species is not a candidate species and is not required to be assessed for species credits under the BAM. Diurnal bird survey (Cockatoos) and incidental survey did not detect evidence of the species inhabiting the subject land. It's plausible the species could utilise the subject land, albeit very infrequently and the subject land does not contain any seasonally important foraging resources. As such, the species was allocated a low likelihood of occurrence and a SIC assessment was not undertaken.
<i>Burhinus grallarius</i> Bush Stone-curlew	I	E	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPBC	BC						
			Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Occurs in lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present.					
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	E	E	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys. A SIC was not undertaken for EPBC Act purposes as the species was not detected and the habitat removal proposed is the culmination of small patches or isolated Eucalypts.
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo	-	V	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			stumps or limbs, either living or dead.					
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (south-eastern)	V	V	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding. Hollows in standing dead or live trees and tree stumps are essential for nesting	Low	No, ecosystem credit species	Yes, incidental only.	Negligible	This species is an ecosystem credit species under the BAM and so targeted survey is not required for this BDAR. However, diurnal bird survey (Cockatoos) and incidental survey has been undertaken. As the species is sedentary in nature, it is likely to have been observed if present. As such, the species is considered to have a low likelihood of occurring and a SIC has not been undertaken.
<i>Dromaius novaehollandiae</i> - endangered population Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	-	EP	On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats. They also occur in plantations of tea-tree and open farmland, and	None	No	Not required	No	Excluded due to geographic limitations. The subject land is not within the Port Stephens LGA.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			occasionally in littoral rainforest. The population of Emus in the NSW North Coast Bioregion and Port Stephens LGA is of significant conservation value as the last known population in northern coastal NSW, and for the role that birds play in dispersing large seeds of native plant species, and over long distances.					
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	M	V	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Hieraaetus morphnoides</i> Little Eagle	-	V	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			trees within farmland, woodland and forests.					
<i>Lathamus discolor</i> Swift Parrot	CR	E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Low	No	Not required	Low	The subject land is not mapped as Important Habitat for this species, therefore, this species is not a candidate species and is not required to be assessed for species credits.
<i>Limicola falcinellus</i> Broad-billed Sandpiper (Breeding)	-	V	Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat.	Low	No	Not required	Low	Excluded due to habitat constraint. The subject land is not within the Important Habitat Map for this species.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.					
<i>Lophoictinia isura</i> Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Ninox connivens</i> Barking Owl	-	V	Generally found in open forests, woodlands, swamp woodlands, farmlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Territories are typically 2000 ha in NSW habitats. Hunts small arboreal mammals or birds and	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			terrestrial mammals when tree hollows are absent.					
<i>Ninox strenua</i> Powerful Owl	-	V	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Pandion osprey</i> Eastern Osprey	-	V	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Tyto novaehollandiae</i> Masked Owl	-	V	The Masked Owl is found in range of wooded habitats that provide tall or dense mature trees with hollows suitable for nesting and roosting. It is mostly seen in open	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			forests and woodlands adjacent to cleared lands. Prey includes hollow-dependent arboreal marsupials and terrestrial mammals.					
Mammals								
<i>Cercartetus nanus</i> Eastern Pygmy-possum	-	V	Patchily distributed from the coast to the Great Dividing Range, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects. Will often nest in tree hollows, but can also construct its own nest. Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney	Recorded	Yes	Yes	Yes	Species precautionarily recorded via acoustic detection. Impacts to foraging habitat only as no breeding

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPBC	BC						
			Basin and Hunter Valley. Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing maternity roost is in a sandstone cave near Coonabarabran.					habitat is present within the subject land. A SIC undertaken for EPBC Act purposes found that are significant impact is not likely as only a small area of foraging habitat is proposed to be impacted
<i>Dasyurus maculatus maculatus</i> (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	E	V	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites. Mostly nocturnal, although will hunt during the day; spend most of the time on the ground, although also an excellent climber and will hunt possums and gliders in tree hollows and prey on roosting birds. Use communal 'latrine sites',	Low	No, ecosystem credit species	Habitat assessment only	Negligible	This species is an ecosystem credit species under the BAM and targeted survey is not required under NSW legislation. Records of the species are distributed widely in eastern NSW including the Hunter Valley region. Typically these are situated in higher elevation areas rather than valley flats within and fringing reserved lands. No evidence of the species, such as latrine sites, was observed through habitat assessment or incidental survey. Furthermore,

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals.					the subject land is disconnected from large areas of preferred habitat by road infrastructure, the Hunter River and various mining operations. In consideration of the above, the species was allocated a low likelihood of occurrence and a SIC assessment was not undertaken.
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	-	V	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.	Recorded	Yes	Yes	Yes	Species recorded via acoustic detection. Impacts to foraging habitat only.
<i>Myotis macropus</i> Southern Myotis	-	V	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels,	Recorded	Yes	Yes	Yes	Species precautionarily recorded via acoustic detection. Impacts to species polygon calculated and credit

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.					liability included in credit report.
<i>Petauroides volans</i> Southern Greater Glider	E	-	The distribution of the Greater Glider includes the ranges and coastal plain of eastern Australia, where it inhabits a variety of eucalypt forests and woodlands. Presence and density of Greater Gliders is related to soil fertility, eucalypt tree species, disturbance history and density of suitable tree hollows. Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.
<i>Petaurus norfolcensis</i> Squirrel Glider	-	V	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Live in family groups of a single adult male one or more adult females and offspring.	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.					
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	V	E	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices particularly with northern aspects. The species forages on grasses and forbs.	Negligible	No	No	Negligible	Survey not required due to lack of habitat constraint.
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	-	V	The Brush-tailed Phascogale had a scattered distribution centred around the Great Dividing Range. It prefers open forests with a sparse ground cover, but also inhabits mallee and rainforests. It feeds on insects and nectar, particularly in rough-barked trees. Nests and shelters in tree hollows, tree stumps and occasionally birds' nests, and can use more than 40 nests in a year.	Recorded	Yes	Yes	Yes	Species precautionarily recorded via camera traps. Impacts to species polygon calculated and credit liability included in credit report.
<i>Phascolarctos cinereus</i>	E	E	In NSW the Koala mainly occurs on the central and north coasts	Low	Yes	Yes	Negligible	Species not recorded during targeted surveys. No SIC

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
Koala			with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include <i>Eucalyptus robusta</i> , <i>E. tereticornis</i> , <i>E. punctata</i> , <i>E. haemostoma</i> and <i>E. signata</i> . They are solitary with varying home ranges.					undertaken due to low likelihood of occurrence.
<i>Planigale maculata</i> Common Planigale	-	V	The Common Planigale is known to occur in a variety of habitats from weed-infested urban reserves to cool mountain forests, from sea level up to 400 m. Habitat selection is considered to be dependent on an adequate surface cover of grasses, hollow logs, rocks and leaf litter. It feeds on insects, spiders and small lizards. This species shelters under rocks, timber, rubbish and termite mounds.	Low	Yes	No	Negligible	Suitable habitat not present.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation.	Recorded (foraging only)	No	Not required	Yes	This species would utilise the subject land for foraging, however, habitat assessment confirmed that that no breeding camps are present, therefore, no further assessment is required under the BAM. A SIC undertaken for EPBC Act purposes found that

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
								are significant impact is not likely as only a small area of foraging habitat is proposed to be impacted.
<i>Vespadelus trougtoni</i> Eastern Cave Bat	-	V	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. Little is understood of its feeding or breeding requirements or behaviour.	Low	Yes	Yes	Yes	No known breeding or roosting sites within the subject land. May forage within the subject land on occasion if utilising mining infrastructure/tunnels in the broader locality.
Amphibians								
<i>Litoria aurea</i> Green and Golden Bell Frog	V	E	Most existing locations for the species occur as small, coastal, or near coastal populations. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby	Low	No	No	Negligible	Species considered unlikely to occur due to degradation (poor quality) of microhabitats. Potential habitat (dams) contain turbid or no water and are used by livestock. No SIC undertaken due to low likelihood of occurrence.

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
			such as vegetation or rocks , although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land.					
Reptiles								
<i>Aprasia parapulchella</i> Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass <i>Themeda australis</i> . Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.; Commonly found beneath small, partially-embedded rocks, however, not all sites are rocky. For instance, on the Hay Plains the species has been recorded from a disturbed ants nest in chenopod shrubland and the West Wyalong population occurs in mallee woodland.	Low	No	No	Negligible	This species was not generated by the BAM-C as a potential candidate species as it is not associated with the PCTS present with the subject land. The subject land is generally west of the species core distribution although a small number of scattered records occur within the central and lower Hunter Valley (DPE 2024). Although rocks are not a strict requirement, the general lack thereof within the subject land does reduce the likelihood of the species occurring. The species was also not incidentally recorded during reptile surveys. No SIC

Species	Status		Habitat Description	Potential occurrence in subject land	BAM Candidate species	Survey required/undertaken	Potential for impact	Conclusion and rationale
	EPB C	BC						
								undertaken due to low likelihood of occurrence.
<i>Delma impar</i> Striped Legless Lizard	V	V	Generally occurs in lowland native grasslands occurring on gently undulating plains having soils of basaltic origin. Grasses are dominated by perennial, tussock-forming grasses such as Themeda triandra, Austrostipa spp. and Austrodanthonia spp. Inhabits secondary grasslands only when they occur within 2km of primary grassland.	Recorded	Yes	Yes	Yes	Species recorded via artificial cover grids and monitoring traps. Impacts to species polygon calculated and credit liability included in credit report. Potential significant impact under the EPBC Act.

Appendix 5 *Delma vescolineata*

Taxonomy

The *Delma vescolineata* is newly recognised as a distinct species separate from Striped Legless Lizard *D. impar* and was described as such in July 2022 (Mahony et al. 2022). The published description provides all that is currently known about the species and the following background information is summarized from that source (Mahony et al. 2022). The population in the Hunter Valley region was discovered in 2012 and was thought to be an outlier of the Striped Legless Lizard *Delma impar* until recent research demonstrated it to be a separate taxon with distinct genetic and morphological characters. However, genetics demonstrates that it is most closely related to Striped Legless Lizard.

Conservation status

D. vescolineata is not listed under provisions of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) for threatened species currently, however it is under assessment for potential threatened species listing under the Act, with the assessment due 30 April 2024. To-date the species is also not listed as threatened under the NSW Biodiversity Conservation Act 2016 (BC Act). The Commonwealth, States and Territories have agreed to implement a Common Assessment Method for the assessment and listing of threatened species. That process may be implemented in NSW by the application of Section 4.14 of the BC Act. By that mechanism, if the species was to be assessed to be under a category of threat under the EPBC Act and the NSW Threatened Species Scientific Committee is satisfied with that assessment, it can accept the assessed threat status for the purposes of the BC Act.

Striped Legless Lizard is listed as vulnerable under the EPBC Act and the BC Act and as *D. vescolineata* was formerly considered to comprise a sub-population of the Striped Legless Lizard, it is reasonable to expect that it will meet the criteria for a threatened list status under both Acts.

Hypothetically, if *D. vescolineata* is still not listed at the time of approval, and *D. vescolineata* is found at the site during any surveys, however assumed to be Striped Legless Lizard for the purposes of approval conditions and current listing status, with any credit obligation generated, then it is likely a two year period from the conditions of consent being issued will apply as per advice on August 2022 for the Mount Pleasant Optimisation Project (SSD-10418).

"If the Legless Lizard, Delma vescolineata, is listed as a threatened species under the BC Act within 2 years of the date of commencement, or otherwise agreed by the Planning Secretary, the Applicant must retire the applicable biodiversity credits (consistent with the applicable Biodiversity Risk Weighting) within 2 years of the species being listed as a threatened species under the BC Act".

Appendix 6 Significant Impact Criteria assessments

Central Hunter Valley eucalypt forest and woodland

Central Hunter Valley eucalypt forest and woodland is listed as critically endangered under the EPBC Act. This community is comprised of eucalypt woodlands and open forests; typically with a shrub layer of variable density and/or a grassy ground layer. Across its range, one or more of a complex of four eucalypt tree species typically dominate the canopy. This community occurs in the Hunter Valley (primarily in the Central Hunter) on Permian sedimentary substrates mostly within, Muswellbrook, Singleton and Cessnock LGAs.

The community has undergone a severe decline and continues to face threats such as; heavy grazing, cropping, exotic plants and loss of community functioning (Cth DCCEEW 2022). There is no adopted or made Recovery Plan for this ecological community.

Occurrence in the subject land and disturbance footprint

The Central Hunter Valley eucalypt forest and woodland ecological community generally occurs on soils derived from the Permian sedimentary bedrock found on the valley floors and on lower hillslopes and low ridges (Cth DCCEEW 2022).

The Central Hunter Valley eucalypt forest threatened community aligns with PCT 3431 (3431_High and 3431_Regen) which was recorded primarily in the eastern half of the subject land covering 43.2 hectares. The community also extends to the adjacent land around the subject land, most prominently to the east.

The Project will impact this community directly (clearing) in small areas in the south-east of the subject land, covering 1.83 hectares.

Based on a strong understanding of the extent and condition of this community in the subject land and surrounds, it is concluded that Project impacts will not lead to a significant impact to the *Central Hunter Valley eucalypt forest* critically endangered ecological community. It is critical that specific mitigation measures are adhered to and the construction footprint is reduced to the minimum extent possible in areas that contain the community. An assessment and justification is provided in the table below.

Table A 6: SIC assessment for Central Hunter Valley eucalypt forest and woodland

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Reduce the extent of an ecological community.	Unlikely	The removal of up to 1.83 ha of low quality Central Hunter alley eucalypt forest will reduce the area of the community, however, it is unlikely to significantly reduce the local or broader extent of the community.
Fragment or increase fragmentation of an ecological community.	Unlikely	The Project is located on the western edge of a large patch of the community. Given the small impact (1.83 ha) the Project would not increase the disconnect between patches of the community.

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Adversely affect habitat critical to the survival of an ecological community.	Unlikely	There is no adopted or made Recovery Plan for this ecological community and no critical habitats have been formerly identified by the Australian Government. Temporary disturbance by construction activities is unlikely to cause serious or long-term impacts on habitat critical to the survival of the community in a broader context as there will be the opportunity to minimise impacts during construction and rehabilitate land to allow for the future re-establishment of native vegetation cover and connectivity to adjacent areas.
Modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	Unlikely	Construction is likely to result in temporary disturbance. It is not expected to affect abiotic factors, given it is small and linear in nature. Areas of temporary disturbance could be rehabilitated through stockpiling of and reinstatement of top soil to allow native grassland species to recolonise. Land surfaces and drainage features (micro-relief) could also be reinstated as part of land rehabilitation.
Cause a substantial change in the species composition of an occurrence of an ecological community, including a decline or loss of functionally important species, for example through regular burning or flora and fauna harvesting.	Unlikely	The community occurs in a highly fragmented agricultural and residential landscape where existing land use impacts have most likely reduced community integrity and functionality (e.g. loss of small native mammals, reduced flora species richness, reduced genetic exchange across the community due to fragmentation). While it is unlikely that the disturbed areas will regenerate to a pre-disturbance state, it is reasonable to assume that the impacted areas will regenerate to the low quality state present prior to construction.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: - Assisting invasive species establishment - Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.	Unlikely	Most locations where this community may occur are subject to existing weed invasion, pest animals, erosion and chemical inputs as a result of surrounding agricultural and residential land use. Construction activities can be managed through standard practices to avoid further sedimentation and pollution and detailed in the CEMP. As stated above, it is widely acknowledged that native rehabilitation post-disturbance is unlikely to achieve complete restoration with increased weed cover recognised as the greatest challenge during restoration/recovery. However, the proposed development occurs in an area where there is a native base to assist regeneration and it could be reasonably assumed that native species will naturally regenerate over time.

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Interfere with the recovery of an ecological community.	Unlikely	There is no adopted or made Recovery Plan for this ecological community and therefore recovery priorities (actions and locations) have not been formerly articulated by the Australian Government. The action is considered unlikely to interfere with recovery actions.

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and Southeast Queensland ecological community

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and Southeast Queensland ecological community (Coastal Swamp Oak Forest) is listed as Endangered under the EPBC Act. The community is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of coastal floodplain communities. The structure of Coastal Swamp Oak Forest can vary from forest to woodland depending on its location in the landscape and disturbance history. The canopy layer is dominated by Swamp oak *Casuarina glauca*. This often occurs as a relatively uniform upper layer of swamp oak, with height and density dependent on the local environmental conditions. A number of Eucalypt species including Forest Red Gum *Eucalyptus tereticornis*, Bangalay *E. botryoides*, Flooded Gum *E. grandis* also emerge from the canopy, with a present but typically sparse mid-layer of species including Lilly Pilly *Acmena smithii*, Red Ash *Alphitonia excelsa*, Cheese Tree *Glochidion ferdinandi*, and a groundlayer of continuous to semi-continuous cover of either forbs, ferns, sedges, grasses and/or plant litter with species including Swamp water fern *Blechnum indicum*, Tussock Sedge *Carex appressa*, Pennywork *Centella asiatica* (DoEE 2018).

Coastal Swamp Oak Forest within the subject land and disturbance footprint

Coastal Swamp Oak Forest aligns with PCT 4015_Moderate within the subject land. This vegetation zone is associated with the higher order waterways within the subject land and generally occurs as thin, riparian vegetation. The disturbance footprint intersects this community in one small area where a waterway crossing is proposed. Impacts are expected to be no more than 0.10 hectares with little woody vegetation removed.

Table A 7: SIC assessment for Coastal Swamp Oak Forest

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Reduce the extent of an ecological community.	Unlikely	Coastal Swamp Oak Forest within the subject land occurs in relatively linear patches along waterways. Impact is proposed in one location to remove up to 0.10 ha of the community and install a water crossing. This is a negligible impact would not reduce the local or broader extent of the community in any effectual way
Fragment or increase fragmentation of an ecological community.	Unlikely	The proposed impact to the community is at the site of an existing creek crossing where there is already a small break in canopy cover. The Project would utilise this already cleared section, but may increase the existing separation by a small degree. In context, this impact is negligible and would not fragment or increase fragmentation of the community.
Adversely affect habitat critical to the survival of an ecological community.	Unlikely	There is no adopted or made Recovery Plan for this ecological community and no critical habitats have been formerly identified by the Australian Government. Temporary disturbance by construction activities is unlikely to cause serious or long-term impacts on habitat critical to the survival of the community in a broader context as there will be the opportunity to minimise impacts during construction and rehabilitate land to allow for the future re-establishment of native vegetation cover and connectivity to adjacent areas.

Significant impact criteria (critically endangered / endangered community)	Likelihood of significant impact	Justification
Modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.	Unlikely	Construction is likely to result in temporary disturbance. It is not expected to affect abiotic factors, given it is small and linear in nature. Areas of temporary disturbance could be rehabilitated through stockpiling of and reinstatement of top soil to allow native grassland species to recolonise.
Cause a substantial change in the species composition of an occurrence of an ecological community, including a decline or loss of functionally important species, for example through regular burning or flora and fauna harvesting.	Unlikely	Given the impact proposed is small, the Project would not cause a substantial change in species composition of the community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: <i>- Assisting invasive species establishment</i> <i>- Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.</i>	Unlikely	Most locations where this community may occur are subject to existing weed invasion, pest animals, erosion and chemical inputs as a result of surrounding agricultural and residential land use. Construction activities can be managed through standard practices to avoid further sedimentation and pollution and detailed in the CEMP. The proposed impact occurs in an area where there is a native base to assist regeneration and it could be reasonably assumed that native species will naturally regenerate over time.
Interfere with the recovery of an ecological community.	Unlikely	There is no adopted or made Recovery Plan for this ecological community and therefore recovery priorities (actions and locations) have not been formerly articulated by the Australian Government. The action is considered unlikely to interfere with recovery actions.

Large-eared Pied Bat *Chalinolobus dwyeri*

The Large-eared Pied Bat is a medium-sized insectivorous bat measuring a total length of approximately 100 millimetres and weighing 7–12 grams. The species is listed as Endangered under the EPBC Act. The species' current distribution is poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW in the south (Hoye 2005). Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously thought. Much of the known distribution is within NSW. Available records suggest that the largest concentrations of populations appear to be in the sandstone escarpments of the Sydney basin and the north-west slopes (Coolah Tops, Mt Kaputar, Warrumbungle National Park and Pilliga Nature Reserve). Although the species is widely distributed, it is uncommon and patchy within this area.

The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites, particularly box gum woodlands or river/rainforest corridors which are used for foraging. Almost all records have been found within several kilometres of cliff lines or rocky terrain. Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin *Hirundo ariel* nests.

Only four maternity roosts have been discovered in NSW, with two of these since abandoned due to flood and disturbance by macropods (Pennay 2008). The structure of maternity roosts appears to be very specific (arch caves with dome roofs). Caves need to be high and deep enough to allow juvenile bats to learn to fly safely inside and have indentations in the roof. Roosting bats cluster in these indentations, presumably to allow the capture of heat. These physical characteristics are very uncommon in the landscape and their scarcity presumably poses an important limiting factor in the distribution of the Large-eared pied bat (Pennay 2008).

Large-eared Pied Bat populations

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area (EPBC Act). In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

To date, there have been no genetic studies undertaken on the Large-eared Pied Bat. Movement of this species between areas has not been recorded and its dispersal ability and habits are not known (DERM 2011). Thus, it is difficult to define 'populations' of the species.

In addition to the individual or individuals recorded during targeted survey for this BDAR, 26 occurrences of Large-eared Pied Bat have been recorded within 10 kilometres of the subject land with the most recent in 2019 and nearest just over two kilometres away (DPE 2023d). While very little is known about the distribution or size of populations of this species, for the purpose of this assessment these records are considered to make up the local population.

The Project will likely result in the following impacts to Large-eared Pied Bat habitat:

- Loss of 10.89 hectares of potential foraging habitat.
- Indirect impact (via noise, light, dust or vibration) to surrounding foraging habitat, primarily during construction.

Table A 8: SIC assessment for Large-eared Pied Bat

Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
Is there a real chance that the action could lead to a long-term decrease in the size of an important population of a species?	Unlikely	Information about the size, distribution and interactions of Large-eared Pied Bat populations is largely unknown. The local population, defined from records nearby the subject land, is considered unlikely to suffer long-term decrease due to the small nature of impact (10.89 ha of foraging habitat only) and that the majority (9.07 ha) of the impact is via removal of single or small patches of trees.
Is there a real chance that the action could reduce the area of occupancy of a population?	Unlikely	The removal of 10.89 ha of foraging habitat would not reduce the area of occupancy of the species which is vast across NSW and beyond. Additionally, no breeding habitat would be impacted.
Is there a real chance that the action could fragment an existing important population into two or more populations?	Unlikely	The removal of 10.89 ha of foraging habitat, largely via removal of small patches or single trees is unlikely to fragment a population of this highly mobile species.
Is there a real chance that the action could adversely affect habitat critical to the survival of a species?	Unlikely	Habitat critical to the survival of the species is defined as (DERM 2011): • Maternity roosts. • Sandstone cliffs and fertile wooded valley habitat within close proximity of each other. The subject land does not support habitat suitable for a maternity roost or sandstone cliffs. The foraging habitat is not within close proximity of sandstone cliffs. Therefore, the Project is considered unlikely to adversely impact critical habitat.
Is there a real chance that the action could disrupt the breeding cycle of a population?	Unlikely	As above, it is unlikely that the local population of Large-eared Pied Bat utilising the subject land is doing so for breeding purposes. Thus, it is unlikely that the proposed works would disrupt the breeding cycle of a population via the removal of foraging habitat alone.
Is there a real chance that the action could modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Unlikely	The proposed works will likely result in the following impacts to Large-eared Pied Bat habitat: • Loss of 10.89 ha of potential foraging habitat. • Disturbance (via noise, light, dust or vibration) to neighbouring foraging habitat. Loss of 10.89 ha of potential foraging habitat within a vegetation patch in excess of 600 ha is unlikely to cause the species to decline.

Significant impact criteria (Vulnerable species)	Likelihood of significant impact	Justification
Is there a real chance that the action could result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Unlikely	The subject land and surrounds likely support several invasive animal species including Red Fox <i>Vulpes vulpes</i> and Feral cats <i>Felis catus</i>. The CEMP and OEMP will detail monitoring and management measures to ensure that the presence of such species does not increase due to proposed works, for example through increases in rubbish that might attract pest species. Weeds occurring within the subject land are common with those occurring within adjacent vegetation to be retained. Measures to ensure adequate control of weeds and pathogens will be detailed and managed by biosecurity measures outlined in the CEMP and OEMP. Overall, no increase in invasive animals or plants is predicted as a result of the proposed works.
Is there a real chance that the action could introduce disease that may cause the species to decline?	Unlikely	The IUCN Species Survival Commission released a statement on 19 June 2020 stating that there is a credible risk of human-to-bat transmission of SARS-Cov-2, a virus currently circulating the globe and causing a pandemic of the illness Covid-19 (IUCN SSC 2020). However, introduction of this disease to Large-eared Pied Bats within the subject land as a result of the proposed works is unlikely for the following reasons: • The species has not been recorded at the Wongawilli pit top despite extensive previous survey, and is not considered likely to be present. • No contact or sharing of closed areas between humans and bats is expected as a result of the proposed works. The transmission of SARS-Cov-2 is considered unlikely as a result of the proposed works.
Interfere substantially with the recovery of the species.	Unlikely	The following recovery objectives have been specified within the National recovery plan for the Large-eared Pied Bat: • Identify priority roost and maternity sites for protection. • Implement conservation and management strategies for priority sites. • Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat. • Research the large-eared pied bat to augment biological and ecological data to enable conservation management. • Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat. The removal of 10.89 ha of predominantly poor quality foraging habitat is considered not to interfere with the above objectives or the recovery of the species generally given the abundance of similar habitat locally.

Grey-headed Flying-fox *Pteropus poliocephalus*

Grey-headed Flying-fox is listed as Vulnerable under the Commonwealth EPBC Act. The Grey-headed Flying-fox trends with the distribution of plants with similar flowering and fruiting times, support regular annual cycles of migration (Eby & Lunney 2002). It can be associated with flowering eucalyptus dependant on seasonality. Key threats to the Grey-headed Flying-fox include habitat fragmentation and habitat degradation, low levels of mortality, exploitation and competition. The species is largely impacted by urban growth displacing individuals.

Occurrence in the subject land

Grey-headed Flying-fox was incidentally recorded foraging within the subject land during spotlighting surveys. Given the available resources and that in the intact vegetation surrounding the subject land, the locality contains high quality foraging resources. No camp sites were detected within the study area or subject land during the field investigation.

The Project would result in the removal of up to 10.89 hectares of native vegetation, which constitutes foraging habitat for the species. An assessment of whether the proposed Project is likely to lead to a significant impact Grey-headed Flying-fox is provided below.

Table A 9: SIC assessment for Grey-headed Flying-fox

Significant impact criteria (vulnerable species)	Likelihood of significant impact	Justification
Lead to the long-term decrease in the size of an important population of a species	Unlikely	While the proposal will result in the removal of potential foraging resources for Grey-headed Flying-fox, the total area of habitat being removed is small in context when the surrounding habitat is considered. No breeding camps would be impacted. The species prefers large consolidated vegetation communities that produce significant foraging resources. Given the scale of the impact it is unlikely that it will lead to a long-term decrease in the size of an important Grey-headed Flying-fox population.
Reduce the area of occupancy of an important population	Unlikely	The species is highly mobile and relatively widespread, roosting and maternity sites are well documented and conspicuous. No roosting or breeding habitat was recorded during field assessment. The species will continue to forage in retained habitat either side of the Project footprint and the development will not represent a barrier to the movement of individuals.
Fragment an existing important population into two or more populations	Unlikely	The national population of the Grey-headed Flying-fox is considered a single population as it is a highly mobile species. The proposed removal of up to 10.89 ha of potential foraging habitat for the species will not fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Unlikely	Habitat critical to the survival of the Grey-headed Flying-fox includes important breeding and foraging resources. Breeding occurs within camps, the nearest known of which is located in the town of Singleton, approximately 10 km to the south-east.

Significant impact criteria (vulnerable species)	Likelihood of significant impact	Justification
		Limiting foraging resources may constitute habitat critical for the survival of Grey-headed Flying-fox and may include areas with highly productive winter flowering tree species. It is considered unlikely the habitat within the disturbance footprint within the subject land would constitute habitat critical to the survival of the Grey-headed Flying-fox for the following reasons: - No camps will be impacted by the proposed development. - Low condition vegetation within the subject land is considered unlikely to be selected as a roosting site in the future as the vegetation patch is relatively small and partially fragmented.
Disrupt the breeding cycle of an important population	Unlikely	While the Project may result in the removal of vegetation utilised for foraging by the species, the Project will not result in the disruption to the breeding cycle of any local Grey-headed Flying-fox population or the species as a whole. The proposal will not provide further disturbance from noise or lighting pollution that will substantially interfere with the species' ability to reproduce successfully as the subject land is not within close proximity to breeding areas. Grey-headed Flying-foxes will continue to breed in camps unaffected by vegetation loss and as a result the breeding cycle of the population will not be disrupted.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely	Grey-headed Flying-foxes are assumed to utilise the subject land on occasion for foraging. The Project will impact a contextually small area of habitat on the eastern edge of a patch of habitat covering over 600 ha. small number of trees which may provide foraging resources at certain times of the year. The Project will not impact on any existing camps and is unlikely to have an impact on nearby camps. The subject land is bordered by higher-quality resources as part of intact native vegetation within the locality to the west, therefore the Project will only impact a very small number of resources within the broader landscape. The subject land is considered to have potential to support future camps, however, the large swathe of habitat to the east is considerably more viable. Thus the Project would not remove the only potential camp site as a plethora of opportunities would remain. The proposed development will remove up to 10.89 ha of native vegetation, this will not fragment or isolate the population as it is a contextually small area, and vegetation adjacent the subject land is largely intact and native. While the Project will result in the removal of trees, some of which may be used by the species, this level of loss is not likely to result in the decline of the species at a local or national scale.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely	There are a moderate number of feral animals and plants that are known or likely to be well established in the subject land. Some of these have potential to negatively impact Grey-headed Flying-fox including foxes and dogs. However it is unlikely that the Project would result in the establishment of new species. The proposed action is unlikely to exacerbate the current level of invasive species threat operating within the subject land.

Significant impact criteria (vulnerable species)	Likelihood of significant impact	Justification
Introduce disease that may cause the species to decline	Unlikely	The Project is unlikely to result in the introduction of a disease that could reduce the reproductive output of Grey-headed Flying-foxes in or near the subject land.
Interfere substantially with the recovery of the species	Unlikely	Actions considered likely to substantially interfere with the recovery of the Grey-headed Flying-fox as determined by key threats to the species (DEW 2021) are as follows: - Habitat loss and fragmentation including important foraging species such as Forest Red Gum. - Winter Foraging resources are limited to a narrow coastal strip in QLD and northern NSW. - Spring foraging resources are considered critical to the survival of the species. - Exploitation – shooting of Grey-Headed Flying-foxes to protect fruit crops involves death of the individual and indirect death as a result of shooting of pregnant and lactating females. - Competition and hybridisation – indirect competition by Black Flying-fox which has had a range expansion in the past. - Pollutants, electrocution and pathogens. A disproportionately higher number of lactating females are killed by electrocution on power lines. The Project will not fragment habitat for the Grey-headed Flying-fox and will not significantly contribute to the loss of habitat. The Project will not result in activities likely to result in exploitation of the species as the Project consists of a solar farm, BESS and associated infrastructure. The Project is not likely to increase incidence of competition or hybridisation. The Project is therefore unlikely to substantially interfere with the recovery of the Grey-headed Flying-fox.

Striped Legless Lizard *Delma impar*

The Striped Legless Lizard *Delma impar* is a long, thin-bodied lizard of the Pygopodidae family. The Striped Legless Lizard, like all members of the Pygopodidae, lacks forelimbs and has reduced or vestigial hind limbs (NSW NPWS 1999). Striped Legless Lizards reach a maximum length of approximately 300 millimetres with the tail contributing over half of this length.

Striped Legless Lizards have sometimes been thought to exclusively inhabit native grasslands dominated by *Austrostipa* and *Themeda* species in south-eastern Australia, ranging from the Australian Capital Territory in the north-east to just over the South Australia border in the south-west (DEWHA 2011). However, further studies indicate the species also utilises introduced pasture grass and inhabits cleared woodland areas (NSW NPWS 1999). This more general habitat specification indicates that a dense grassland structure along with suitable soil type, is the principal habitat requirement as opposed to a specific composition of native grass species (Harley et al. 2005).

Major threats to the Striped Legless Lizard include loss of grassland habitat due to urban expansion, particularly on Melbourne's western fringe and habitat modification from agricultural development across the species range (NSW NPWS 1999). Other threats include inappropriate fire regimes and possibly predation by native and introduced predators (NSW NPWS 1999).

The species is listed as vulnerable under the EPBC Act.

Occurrence within the subject land

Striped Legless Lizard was recorded on 32 occasions across eight out of 10 tile grids installed for targeted survey ranging from the northern-most to southern-most grid locations. This result demonstrates that the subject land is home to one, if not several populations of the species. The species may also be more widely distributed within the subject land than is known and could plausibly also inhabit surrounding areas where commensurate habitat (largely derived grasslands) is present.

The Project would result in the removal of up to 75.74 hectares of native vegetation which constitutes habitat for the species. Additionally, there is risk of mortality of individuals resulting from contact with machinery during construction activities. An assessment of whether the proposed Project is likely to lead to a significant impact to Striped Legless Lizard is provided below.

Table A 10: SIC assessment for Striped Legless Lizard

Significant impact criteria	Likelihood of significant impact	Notes
Lead to a long-term decrease in the size of an important population	Possible	The approved Conservation Advice for Striped Legless Lizard under the EPBC Act (Threatened Species Scientific Committee 2016) says, "All populations of the Striped Legless Lizard are likely to be important for the species recovery". As a consequence, the population, or populations, inhabiting the subject land is considered to be part of an important population. Due to the cryptic nature of the species, the precise extent and nature of habitat use within the subject land is somewhat unknown. However, given the number of incidences recorded (noting that one individual could have been recorded more than once) and wide distribution (8 of 10 tile grids) of records which suggests that the subject land houses at least part of a viable population and the area is used for breeding. Compliance with recommended mitigation and rehabilitation measures (Section 5) will serve to protect the species within the subject land, however, an impact (habitat removal) would be suffered which may still lead to long-term decrease in the size of the population
Reduce the area of occupancy of an important population	Likely	Striped Legless Lizards were identified in the subject land and disturbance footprint. The Project will result in the direct removal or modification of known habitat, including impacts on tussock-forming grasses, rocks and soil structure. Therefore, a small reduction in the area of occupancy for an important population is likely to occur.
Fragment an existing population into two or more populations	Likely	Striped Legless Lizards are known to have limited dispersal capability (Threatened Species Scientific Committee 2016) and significant landscape features such as rivers or roads are likely boundaries to their dispersal. With such limited dispersal capability, it is possible that individuals within the subject land, but outside the disturbance footprint may no longer be able to interact, potentially fragmenting one population into two or more populations.
Adversely affect habitat critical to the survival of a species	Unlikely	It is unlikely that the proposed action would adversely affect habitat deemed critical to the survival of the species.
Disrupt the breeding cycle of an important population	Possible	The life history of the Striped Legless Lizard is poorly known. However, it is believed that females deposit up to two eggs every year in December to January, within a soil cavity or under rocks in communal nests. All habitat suitable for the species is understood to also be suitable for the species to breed. The Project may disrupt breeding of individuals utilising the disturbance footprint and the significance of this to the population is unknown. To minimise disruption to the breeding cycle, works should occur outside of the breeding season (December to February).
Modify, destroy, remove, isolate or decrease the	Possible	The Project would remove 75.74 ha of potential habitat. It is anticipated that array areas will naturally be recolonised by grass and groundcover species a kin to what is currently present, however, grassland under

availability or quality of habitat to the extent that the species is likely to decline		and between solar arrays will require some management, and their suitability as ongoing habitat is unknown.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely	The proposed project does not include any known mechanism that would result in the establishment of invasive species harmful to Striped Legless Lizard that are not already present in the local area.
Introduce disease that may cause the species to decline	Unlikely	The proposed works do not include any known mechanism that would result in the introduction of a disease that is not already present in the local area.
Interfere with the recovery of the species	Possible	It is unclear what severity of impact could be considered to interfere with the recovery of the species. The Conservation Advice for species notes that ongoing loss, modification, degradation and fragmentation of the Striped Legless Lizard habitat are the major obstacles to its survival and conservation. The Project would certainly further exacerbate these threats and may curtail the recovery and future viability of the local population which is deemed an important population under the EPBC Act.

In consideration of the above criteria, the Project has the potential to cause a significant impact to Striped Legless Lizard. Therefore, referral of the project was made to the Federal Minister for the Environment and Water, with a controlled action determined.

